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"THE ENGINEER," MAY 27, 1927

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLIII.—No. 3724] LONDON: FRIDAY EVENING, MAY 27, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth S.E.1, invites TENDERS for :—
1. 2,000,000 DOG SPIKES.
About
2. /590 tons of BRIDGEWORK.
About
3. /550 tons of STEEL WORK, &c., for Curbs and Strakes.
Tenders due on the 2nd June, 1927, for No. 1, on the 14th June, 1927, for No. 2, and on the 21st June, 1927, for No. 3.
Specifications and forms of Tender obtainable from the above, at a fee of 5s. per set, which will not be returned. 5580

Assistant Engineer Re QUIRED by the GOVERNMENT of KENYA COLONY for service in connection with the MOMBASA TOWN-PLANNING SCHEME, for a tour of from 20 to 30 months' service, with possible extension. Salary £660, rising to £720 a year by annual increments of £30. Free quarters and passages and liberal leave on full salary. Candidates, aged 30 to 38, must be A.M.I.C.E. or hold equivalent professional qualifications and have had thorough experience of municipal engineering and macadam roads.—Apply at once by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15029. 5570

Assistant Engineers (13) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no absolute guarantee can be given. If at the end of four years' service, an officer's services have been entirely satisfactory and he is not offered or declines further employment he will be paid a bonus of Dols. 2850. Salary Dols. 400 a month, rising to Dols. 800 by annual increments Dols. 25, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No Income Tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a Civil Engineering degree or obtained such other diploma or distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of civil engineering under a qualified civil engineer. Apply at once by letter, giving brief details of qualifications and experience, and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 5 539

Battersea Polytechnic.
LONDON, S.W. 11.
The Governing Body invite APPLICATIONS for the POSITION of PRINCIPAL of the POLYTECHNIC, owing to the resignation of Dr. R. H. Pickard, F.R.S., upon appointment as Director of the British Cotton Industry Research Association.
Salary, £1250-£50-£1500.
Applications to be made not later than June 13th.
Full particulars obtainable on application to the CLERK TO THE GOVERNING BODY. 5518

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that HUBERT ALEXANDER GILL, M.A. Cantab., Chartered Patent Agent, of 51/52, Chancery-lane, London, W.C. 2, England, British subject, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 263,683 granted to him for an invention entitled "Improvements relating to Rolling Mechanisms."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 18th May, 1927.
Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT,
P8220 Comptroller-General.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
Notice is Hereby Given that KENELM EDWARD LEE GUINNESS, of Aranmore, Kingston Hill, in the County of Surrey, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 107,888, granted to him for an invention entitled "Improvements in and connected with Ignition Apparatus for Internal Combustion Engines."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 18th May, 1927.
Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT,
5557 Comptroller-General.

The Engineer

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PUBLIC NOTICES

City and County of Newcastle- UPON-TYNE EDUCATION COMMITTEE.
RUTHERFORD TECHNICAL COLLEGE.
Principal: E. C. EDGAR, Esq., D.Sc., F.I.C.
APPLICATIONS are INVITED from suitably qualified persons for APPOINTMENT, to date from 1st September, 1927, as HEAD of MECHANICAL ENGINEERING DEPARTMENT. Salary scale, minimum £500 per annum, by annual increments of £20, to a maximum of £600 per annum.
Form of application and further particulars will be sent on receipt of stamped addressed foolscap envelope.
Completed applications must be returned to me at the Education Office, Northumberland-road, Newcastle-upon-Tyne, not later than 3rd June, 1927.
THOS. WALLING,
5515 Director of Education.

City of Bradford.
ELECTRICITY DEPARTMENT.
The Electricity Committee of the Bradford Corporation invite TENDERS for the PURCHASE and REMOVAL of :—
(a) ONE Babcock and Wilcox Land Type WATER-TUBE BOILER, heating surface 5540 square feet, working pressure 200 lb. per square inch, complete with Chain Grate Stoker, Superheater and necessary Valves and Mountings.
(b) TWO Hall's Patent Compound, Direct acting, Vertical BOILER FEED PUMPS, having cylinders 10½in. by 18in. by 10½in. by 24in. stroke, complete with Steam and Exhaust Valves and Crosby Automatic Controls, but no Water Valves.
(c) THREE INDUCED DRAUGHT FANS, 132in. diameter, direct coupled to 200 B.H.P. Direct current MOTORS, complete with Flexible Couplings, Combination Bed-plate, and Motor Control Gear.
(d) TWO WROUGHT IRON TANKS, one being 16ft. by 8ft. by 7ft. deep, and the other 8ft. by 8ft. by 7ft. deep.
The whole of the above plant is in good working condition and may be inspected at the Valley-road Power Station by appointment.
Form of Tender may be had on application to the City Electrical Engineer and Manager, 45 to 53 Sunbridge-road, Bradford, to whom all enquiries respecting the plant should be addressed.
Sealed Tenders, endorsed "Tender for Purchase, &c., of Boiler Plant," to be sent so as to reach me not later than 10 a.m. on Wednesday, 8th June, 1927.
N. L. FLEMING, Town Clerk.
Town Hall, Bradford, 20th May, 1927. 5552

PUBLIC NOTICES

Borough of Bexhill.
MAIN DRAINAGE.
CONTRACT NO. 2.
TO CONTRACTORS.
The Corporation of Bexhill are prepared to receive TENDERS for the CONSTRUCTION of an additional STORAGE TANK and for a 48in. CAST IRON SEA OUTFALL and other works, all in accordance with plans and specification prepared by the Engineer, Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.
Contractors desirous of tendering may obtain copies of the general conditions, specification, bill of quantities, and form of Tender and may inspect the drawings at the office of the Engineer upon payment of £5 (cheque only), which will be returned on the receipt of a bona fide Tender.
Tenders, endorsed "Main Drainage, Contract No. 2," must be delivered in a sealed package, addressed to the Town Clerk, Town Hall, Bexhill-on-Sea, before Twelve Noon on Friday, the 17th day of June, 1927.
The Corporation do not bind themselves to accept the lowest or any Tender.
By Order,
S. J. TAYLOR,
Town Clerk.
Town Hall, Bexhill. 5545

Borough of Bexhill.
MAIN DRAINAGE.
CONTRACT NO. 1.
TO CONTRACTORS.
The Corporation of Bexhill are prepared to receive TENDERS for the CONSTRUCTION of 24in. and 30in. CONCRETE TUBE SEWERS and 5ft. by 3ft. 4in. and 5ft. 9in. by 3ft. 6in. EGG-SHAPED SEWERS with MANHOLES and other work, all in accordance with plans and specification prepared by the Engineer, Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.
Contractors desirous of tendering may obtain copies of the general conditions, specification, bill of quantities and form of Tender and may inspect the drawings at the office of the Engineer upon payment of £5 (cheque only), which will be returned on receipt of a bona fide Tender.
Tenders, endorsed Main Drainage, Contract No. 1," must be delivered in a sealed package, addressed to the Town Clerk, Town Hall, Bexhill-on-Sea, before Twelve Noon on Friday, the 17th day of June, 1927.
The Corporation do not bind themselves to accept the lowest or any Tender.
By Order,
S. J. TAYLOR,
Town Clerk.
Town Hall, Bexhill. 5544

PUBLIC NOTICES

Cast Iron Pipe Manufacturers.
3600 Yards 3in. CAST IRON SPIGOT and SOCKET PIPES REQUIRED.
ENGINE AND PUMP CONTRACTORS.
New Engine and Pump required to pump 30,000 gallons per hour.
Tenders to be lodged before the 16th June, 1927.
Full particulars for both from the
TOWN CLERK,
Galway Urban District Council,
P 3234 Ireland.

Derby Poor Law Institution.
BOILER AND BUILDING ALTERATIONS.
The Guardians invite TENDERS for the SUPPLY of a LANCASHIRE BOILER at their Institution, Uttoxeter-road, Derby; also for the CARRYING OUT of the EXTENSION of the present BOILER HOUSE PREMISES.
Specifications and form of Tender prepared by Messrs. Henry Lea and Son, Consulting Engineers, 151-153, Edmund-street, Birmingham, may be had on application to the undersigned.
The Guardians do not bind themselves to accept the lowest or any Tender.
Tenders must be sent in on or before Saturday, the 18th June, 1927, to
RALPH GRANTHAM,
Clerk to the Guardians.
Poor Law Offices, Derby. 5546

Limerick Harbour Commis- SIONERS.
LIMERICK HARBOUR.
CONSTRUCTION OF NEW DOCK.
The Limerick Harbour Commissioners invite TENDERS for the CONSTRUCTION of a NEW DOCK at Limerick, comprising about 6½ acres in extent, including Excavation, Dock Walls, New Entrance and Dock Gates, Entrance Jetties, Dredging and other Works, as provided for in the plans, specification and conditions of contract, which may be inspected at the office of Mr T. F. O'Sullivan, B.E., Harbour Engineer, Limerick, or the office of the Consulting Engineer, Mr. P. H. McCarthy, M.A., B.A.I., M. Inst. C.E.I., 26, Lower Leeson-street, Dublin, during the usual office hours.
Forms of Tender, conditions of contract, specification, and schedule of quantities may be obtained from the undersigned on payment of a deposit of £20, which will be returned on receipt of a bona fide Tender, together with all the aforesaid documents.
Tenders, enclosed in sealed envelopes, addressed to the undersigned and marked "Tender for New Dock," must be delivered at the offices of the Commissioners not later than Ten o'clock a.m. on 20th day of July, 1927.
The Commissioners do not bind themselves to accept the lowest or any Tender nor will the Commissioners be responsible for any expenses incurred by persons tendering.
JOHN F. POWER,
Secretary,
Limerick Harbour Commissioners.
Limerick Harbour Commissioners' Office, Limerick. 5492

The Madras and Southern MAHRATTA RAILWAY COMPANY, Ltd., 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—
42 TONS (Approx.) BOLTS, NUTS, RIVETS, &c.
Tenders are due in on Tuesday, 14th June, 1927, by 3 p.m. Tender form obtainable at above address; fee One Guinea, which is not returnable.
The Directors do not bind themselves to accept the lowest or any Tender. 5576

MACHINE TOOLS AND PLANT FOR SALE.
The Metropolitan Asylums Board offer FOR SALE :—
ONE 6in. by 4ft. 6in. Bradford Mill Co. SCREW-CUTTING LATHE for £25.
ONE 8in. by 6ft. American Tool Works S.S. and S. LATHE for £25.
ONE 9in. by 6ft. Barker and Chard S.S. and S. LATHE for £25.
ONE Richmond GAS MUFFLE FURNACE, 2ft. 7in. by 1ft. 8in. by 3ft. 10in. inside measurements, for £20.
All items are in good working order and the machine tools are complete with accessories. They may be inspected at the Mead Works, Carnwath-road, Fulham, London, S.W. 6, on application to the Engineer-Superintendent. Address communications to the Clerk to the Board, Metropolitan Asylums Board, Victoria Embankment, London, E.C. 4.
ALLAN POWELL,
5561 Clerk to the Board.

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PUBLIC NOTICES

South Indian Railway Company,
LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. POINTS and CROSSINGS.
2. STEEL BEARING PLATES for F.B. Rails.
3. DOG SPIKES, FISH-BOLTS, NUTS and WASHERS.
4. WHEELS and AXLES, &c., for Loco. Engines and Tenders.
5. STEELWORK for BRIDGES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Points and Crossings," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 10th June, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of each specification.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
25th May, 1927 5591

Administrative County of
LONDON.

ROBERT BLAIR FELLOWSHIPS IN APPLIED SCIENCE AND TECHNOLOGY.

The London County Council invites APPLICATIONS for the AWARD of TWO ROBERT BLAIR FELLOWSHIPS in APPLIED SCIENCE and TECHNOLOGY, each of the value of £450, tenable for one year. The Fellowships are for advanced study or research in applied science and technology, and will be tenable in the Dominions, the United States or other foreign countries.

Candidates must be British subjects and at least twenty-one years of age.

Further particulars and applications forms (T.2.a/300) may be obtained from the Education Officer (T.2.a.), The County Hall, S.E. 1 (stamped addressed envelope necessary), to whom the form must be returned by 18th June, 1927.

MONTAGU H. COX,
5425 Clerk of the London County Council.

Administrative County of
LONDON.

The London County Council will REQUIRE in September next, at the L.C.C. School of Engineering and Navigation, High-street, Poplar, E., to give evening instruction :—

- VISITING TEACHER of CARPENTRY and JOINERY, including STAIRCASING and HAND-RAILING, to take charge of the practical work on Monday and Thursday, and to assist with the Drawing Class on Tuesday.
- VISITING INSTRUCTOR of ACETYLENE WELDING, to give instruction in theory and practice to one class for beginners and one for more advanced students on Mondays and Fridays. The acetylene plant comprises both high and low-pressure systems.
- VISITING INSTRUCTOR of ELECTRICAL INSTALLATION WORK for a first-year course in electric installation and wiring, on Mondays and Thursdays, one evening being devoted to drawing and calculations, and the other to the theory and practice of installation work.
- VISITING INSTRUCTOR of ENGINEERING WORKSHOP PRACTICE, on Tuesday, Thursday and Fridays, to give instruction in all such machine processes as fitting, turning, milling, shaping, grinding, drilling, gear cutting, and generating.
- VISITING INSTRUCTOR of ENGINEERING ECONOMICS, to give instruction covering the syllabus of Engineering Economics required for Section "C" of the examinations for the Associated Membership of the Institution of Mechanical Engineers, on Mondays.

Fee for Assistant in the Drawing Class for Carpentry and Joinery 11s., in all other cases 16s.; an attendance of about 3 hours.

Preference given to those who served or attempted to serve with H.M. Forces.

Apply to Education Officer (T.1.a.), The County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope necessary), for form, to be returned by 20th June, 1927. Canvassing disqualifies.

MONTAGU H. COX,
5563 Clerk of the London County Council.

Somersetshire Drainage Com-
MISSIONERS.

APPLICATIONS are INVITED for the POSITION of ASSISTANT ENGINEER, at a salary of from £250 to £300 per annum, according to experience. Applicants must have passed the Associate Membership Examination of the Institution of Civil Engineers, and have had experience in General River Works, more particularly with regard to Sluice Construction. Applications, accompanied by not more than three recent testimonials, stating age and qualifications, should be addressed to the undersigned and received at this office not later than June 7th.

WALTER H. HAILE, M. Inst. C.E.,
Engineer to the Commissioners.
Crowpill House, Bridgewater, Somerset. 5589

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, CHIEF ELECTRICIAN for Large Steel Works in Sheffield district, to Take Charge of Generation, Distribution and Maintenance under Chief Engineer.—Address, 5504, The Engineer Office. 5504 A

WANTED, ENGINEER, Capable of Progressing work through all shops and plant maintenance. Preferably used to Marine Auxiliaries. State age, experience and salary required.—Address, P3243, The Engineer Office. P3243 A

DEPUTY GENERAL MANAGER REQUIRED by Iron and Steel Rod Rolling, Wire and Wire Rope Manufacturing Company in Lancashire, employing over 1000 men. Adequate salary and prospects for the right man. Replies treated in strict confidence (must be typewritten). State age and experience.—Address, 5554, The Engineer Office. 5554 A

ENGINEER REPRESENTATIVES REQUIRED, one for Newcastle, one for Midland areas, for Boiler-house Speciality Apparatus already adopted by Government Departments, leading power stations, &c. Appointment is a whole-time job and offers scope for considerable income to engineer with connection and selling ability. All applications will be treated in confidence and fullest details of experience should be sent.—Address, P3222, The Engineer Office. P3222 A

ENGINEER to SUPERVISE OUTSIDE ERECTION, TESTING and HANDING OVER of ELECTRIC CRANES, &c. State age, salary and full details of training.—Address, 5584, The Engineer Office. 5584 A

MECHANICAL ENGINEER REQUIRED for Straits Settlements as Principal Branch Assistant, with good experience of estimating and dealing with correspondence, and of good presence and address. Five years' agreement. Passage paid. Only single men need apply. Commencing salary £60 per month.—Write, with full details of experience, to Box Z.O. 376, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 5575 A

PROGRESS MAN REQUIRED for Large Engineering Works, London district; must be fully experienced in Machine Shop Progress Work and able to Take Charge of Section if required.—Address, stating age, experience, and salary required, 5524, The Engineer Office. 5524 A

WORKS MANAGER.—APPLICATIONS are INVITED from gentlemen who are experienced in the quantity production of Light Assemblages, such as Typewriters, Cameras, Clocks, &c. Applicants must be familiar with modern labour conditions, men of tact and resource, and competent to take temporary charge of the organisation in the absence of the Managing Director. The works are situated near London, of modern construction and equipment, and employ 1400 workpeople. An attractive salary will be paid to a suitable man, and letters, which should give concise particulars of career, will be treated in strict confidence.—Address, 5560, The Engineer Office. 5560 A

WANTED for North of England, Practical DRAUGHTSMAN, with experience in design of Blocks for Heavy and Light Press Work and design of Jigs.—Write, stating age and salary required, to Z.L. 374, care Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 5573 A

WANTED, Fully Qualified DRAUGHTSMAN for Chemical and Gas Plant Manufacturers; must be familiar with Chemical, Gas and Oil Works Plant. Only competent men need apply. State age, experience and salary required.—Address, 5566, The Engineer Office. 5566 A

WANTED IMMEDIATELY for Power Station Work, a GENERAL ENGINEERING DRAUGHTSMAN, with experience in design of Steel and Brick Buildings. Preference given if capable of supervising erection. Give full particulars, age, and salary required.—Address, 5548, The Engineer Office. 5548 A

WANTED, Near Gainsborough, Young STRUCTURAL ENGINEER and DRAUGHTSMAN, with good technical education, preferably university.—Address, 5565, The Engineer Office. 5565 A

DRAUGHTSMAN-DESIGNER.—YOUNG MAN REQUIRED, with experience on Commercial Vehicle Design, particularly Road Wheels for Lorries; able to organise and develop a small department. Good prospects for energetic man.—Address, stating experience and salary required, P3240, The Engineer Office. P3240 A

DRAUGHTSMAN, Experienced and Accustomed to work under slight supervision, preferably with Mechanical Engineering experience, particularly in connection with the manufacture of Waterworks Fittings.

Write in confidence, with full particulars of salary required, age, experience, and positions held, SECRETARY, Guest and Chrimes, Limited, Rotherham. 5577 A

DRAUGHTSMAN REQUIRED, with Experience in the design of all classes of Jigs, Tools and Fixtures for accurate production. London district.—Address, stating age, experience and salary required, 5587, The Engineer Office. 5587 A

DRAUGHTSMAN REQUIRED, with Experience in Design of Reciprocating Pumping Machinery, preferably with shop training.—Address, giving full particulars and salary required, 5585, The Engineer Office. 5585 A

DRAUGHTSMAN WANTED, to Design and Detail Structural Steel Work. Experience in Conveying Plant to would be an advantage, but not essential.—Write, giving full particulars, to W. J. JENKINS and CO., Ltd., Conveying and Constructional Engineers, Retford, Notts. 5568 A

DRAUGHTSMAN WANTED by Lift Manufacturers in the Midlands. Mechanical and constructional experience desirable. Please reply, giving particulars of experience, age, and wages required.—Address, 5555, The Engineer Office. 5555 A

DRAUGHTSMAN WANTED, Used to Enclosed Refrigerating Machines, London. Age, experience, salary.—Address, P3238, The Engineer Office. P3238 A

LOCOMOTIVE DRAUGHTSMAN, for Design and estimating; experience in Electric Locomotives an advantage. State experience, age, and salary.—Address, 5567, The Engineer Office. 5567 A

REQUIRED for South-East London, DRAUGHTSMAN with previous experience of preparing workshop details for Structural Steel Work. When applying state age and salary expected. Also give outline of previous experience.—Address, 5562, The Engineer Office. 5562 A

STRUCTURAL DRAUGHTSMEN.—SENIOR and ASSISTANT DRAUGHTSMEN REQUIRED, accustomed to detailing Constructional Steel Work.—Apply, stating age, experience, salary required, and when at liberty, to CHIEF DRAUGHTSMAN, Redpath, Brown and Co., Ltd., Trafford Park, Manchester. 5547 A

TRACER (MALE) WANTED, Preferably with Experience in Motor Vehicle Work.—Apply by letter, stating age, giving full particulars of experience and salary expected, to DENNIS BROS., Ltd., Guildford. 5588 A

WANTED, FOREMAN INSPECTOR, to Take Charge of an Inspection Department of Electrical Instrument Manufacturing Firm on bulk production. Applicant must have intensive experience on Watch and Clock Work, and be conversant with up-to-date Gauging Methods. No application will be considered otherwise.—Address, stating age, experience, and salary required, 5559, The Engineer Office. 5559 A

FOREMAN GRINDER REQUIRED in London; should have held a similar position previously and be accustomed to turning out work to a high degree of accuracy.—Address, stating age, details of experience, in date order, and salary required, 5523, The Engineer Office. 5523 A

FOREMAN REQUIRED, to Take Charge of Millwrights and Machine Tool Repairs in large general engineering factory, London district. Must be fully experienced in this class of work and used to the control of men.—Address, stating age, full details of experience, with names of firms and dates, also salary required, 5569, The Engineer Office. 5569 A

WANTED, First-class FITTER who Understands Erection and Repair of Machinery, also used to Motor Car Repairs.—Address, giving references and stating salary required, 5538, The Engineer Office. 5538 A

SITUATIONS WANTED

A.M.I. MECH. E. SEEKS POSITION of RESPONSIBILITY; technical, commercial and sales experience; excellent connection railways, shipowners, shipbuilders, &c.; accustomed to control of staff. First-class references.—Address, P3241, The Engineer Office. P3241 B

ADVERTISER, Aged 29 Years, DESIRES POST as Assistant to Engineer of Manufacturing Company; 12 years' shops and D.O. experience.—Address, P3228, The Engineer Office. P3228 B

AN ENGINEERING ADVERTISING MAN is OPEN to CONSIDER NEW APPOINTMENT. Has passed through the various channels from engineering shop to ultimately holding position of publicity manager to two world-famous Glasgow engineering firms.

Aged 26, he is fully cognisant with the laying out of advertisements, "copy" writing of technical and general nature, including the making-up of catalogues and booklets.

No reasonable offer refused.
Address, 5564, The Engineer Office. 5564 B

B.O.T. EXTRA CHIEF ENGINEER (32), M.I. Mar. E., R.S.A. Certifs, bookkeeping and commercial correspondence, 12 yrs. large shipping coy., teaching experience, REQUIRES POST, Commercial or Superintendent, &c.—Address, P3232, The Engineer Office, P3232 B

SITUATIONS WANTED (continued)

ENGINEER (26), with University Engineering training, workshop, drawing-office and sea experience (1st Class B.O.T. certificate), REQUIRES PROGRESSIVE POSITION at home or abroad.—Address, P3237, The Engineer Office. P3237 B

ENGINEER (40), Now Abroad, DISENGAGED JUNE, Speaks Spanish, wide constructional, railway, general eng. experience, General and Works Manager, Chief Draughtsman, Foundry, drop stamps, mach. shops, erection, inspection, travelling, &c.—Address, 5524, The Engineer Office. 5524 B

EXPERIENCED DIE-TOOL MAKER, Used to D.A. Drawings, Combination Dies, also knowledge of presses and tools for making up metal stampings. Testimonial if necessary.—Address, P3233, The Engineer Office. P3233 B

FIRST-CLASS MECHANICAL and ELECTRICAL ENGINEER SEEKS POSITION of RESPONSIBILITY. Well educated, fully qualified, age 39. Construction, operation, experimental and commercial experience at home and abroad. Good linguist. Excellent references.—Address, P3195, The Engineer Office. P3195 B

GENERAL MANAGER, with Successful Record as a first-class organiser, DESIRES POSITION. Thoroughly practical engineer, up to date in all duties.—Address, P3231, The Engineer Office. P3231 B

YOUNG ENGINEER (24) REQUIRES SITUATION, technical training, with 5 years' workshop experience; passed A.M.I. Mech. E. exam.—Address, P3219, The Engineer Office. P3219 B

YOUNG ENGINEER (28) SEEKS APP. Ex Public school and tech. training shops, 3 years D.O., 2 years assist. eng. Excellent testimonials.—Address, "Z.M. 375," Deacon's, Fenchurch-avenue, E.C. 3. 5573 B

ASSISTANT MECH. ENGINEER or HEATING DRAUGHTSMAN (26), 12 years' tech., D.O., estimating and workshop experience in mech., automobiles, heating and ventilating engineering. SEEKS MORE SCOPE.—Address, P3244, The Engineer Office. P3244 B

DRAUGHTSMAN, Mechanical, General Factory Work, design (33), WANTS SIT.—111, Melfort-road, Thornton Heath (Croydon), Surrey. P3235 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Charing Cross Bridge Scheme.

IN a Journal note of the 13th inst. we referred to the correspondence which had recently taken place between the Prime Minister and the London County Council with regard to the question of proceeding with the proposal for a new bridge at Charing Cross, which was put forward in the report of the Royal Commission on Cross River Traffic, presided over by Lord Lee. Arrangements have now been made to set up a committee of experts to investigate the proposal. The committee will consist of Messrs. Mott, Hay and Anderson, consulting engineers, of Westminster, appointed by the Ministry of Transport, who will be joined by Mr. G. W. Humphreys, the Chief Engineer of the London County Council, and by an engineer who will be appointed by the Southern Railway Company. The chief valuer to the Board of Inland Revenue and the valuer to the London County Council are also to be members of the committee. If the report of this committee on the engineering, financial and æsthetic aspects of the proposal be deemed satisfactory, then the Government is prepared to contribute 75 per cent. of the actual ascertained expenditure. Indeed it is the determination of the ultimate cost of carrying out the proposal to construct a double-decked road and railway bridge, with its approaches, that the committee of experts will chiefly investigate. The net cost of the works was assessed by the Royal Commission at £8,250,000, but there are those who hold that several million pounds will have to be added to that figure, and estimates are said to range as high as from £15,000,000 to £18,000,000 if compensation for disturbance is to be taken into account.

The Late Professor M. F. Fitzgerald.

THE recent death of Professor Maurice Frederick Fitzgerald will be greatly regretted by civil engineers and the many students with whom he came in contact during over a quarter of a century of engineering educational work at Belfast. Professor Fitzgerald was the eldest son of the late Bishop of Killaloe and was born in 1851. At the age of sixteen he entered Trinity College at Dublin, from which four years later he graduated with honours. In 1872 he became a pupil with the firm of Messrs. Easton and Anderson at the Erith Ironworks, and his work with that firm included experience with sewerage work at Doncaster and the erection of pumping plant on the Clyde. He visited Russia in 1875 to erect pumps at the Cronstadt graving docks, and was later employed by the Russian Government on civil engineering works both at Riga and Odessa. On his return to Ireland he took an important share in the carrying out of drainage works on the river Shannon. In 1884 he was appointed to the Chair of Engineering at Queen's College, Belfast, and for a period of twenty-six years he filled that post with conspicuous success. He was a keen mathematician and a great teacher, and he excelled in making simple models and apparatus for teaching purposes. Before he retired in 1910 he laid down the main lines upon which the engineering school and laboratories in the reconstituted Queen's University, Belfast, were to be later developed. Professor Fitzgerald was particularly happy in his educational work and, apart from his teaching activities at the College, he took great interest in the improvement of both the status and working methods of the craftsmen who were employed in plumbing and drainage work. He read some papers on whirling discs and rotating shafts, which were published in the "Proceedings" of scientific societies, and prepared a contour map of the Mourne Mountains, which was based upon his own barometric observations.

The Eight Hours' Day.

THE recommendation of the Washington Conference fixing the working day at eight hours has been accepted by the French Chamber of Deputies, after modification by the Senate, which makes the vote one of pure form with the idea of giving satisfaction on a question of principle. Parliament approved of the recommendation on condition that it became law in Great Britain and Germany. It is believed that Great Britain will never adopt a measure which aims at making the eight hours' working day general in all industries, for experience in France, where the eight hours' day exists, has shown that this is practically impossible, and the French legislation had to be made sufficiently elastic to permit of its being adapted in such a way that the number of working hours could be modified to meet special conditions. In the merchant marine the experiment was disastrous. It has also failed in other countries, and in Italy, Switzerland and Germany employers and men are practically free to agree amongst themselves upon the number of working hours. So far as Europe is concerned it is recognised that any attempt to shorten the working day unduly will prevent the successful carrying out of the programme of industrial reconstruction which aims at bringing down costs by increasing production. Logically, the length of the working day can only be governed by industrial conditions. The country, for example, might suffer considerable loss if farm labourers were compelled to stop work at the end of a normal day when their services were required to save crops, or even to increase the production of indispensable commodities. Logically, also, a universal eight hours' measure would imply an increase in the number of working hours in collieries and in other industries where fewer hours are worked. In passing the Bill in favour of a universal eight hours' day the French believe that they are safe behind the opposition of Great Britain and Germany.

An Imperial Air Policy.

AT the Colonial Conference held at the Colonial Office, London, on Thursday of last week, May 19th, Sir Samuel Hoare, the Secretary of State for Air, opened a discussion on the question as to how far civil aviation might be used as a means of furthering the development of colonial territories. He emphasised the necessity for an Imperial air policy which would be based upon the combined efforts of the Mother Country, the Dominions and the Dependencies. With regard to the British policy, it was suggested that it was intended to make civil aviation self-supporting at the earliest possible moment and to give every incentive to the Imperial Airways Company to free itself from dependence upon Government subsidies. Sir Samuel stated that in the last five years the running costs of the Imperial Airways machines had been reduced from 4s. 2d. to 1s. 10d. per ton-mile. Definite advance had also been made, he said, in the development of a heavily laden and comparatively slow machine, which might be termed an "air tramp," which was more economical for the transportation of goods than a passenger-carrying machine. Sir Samuel suggested that the cost of running an air service might be reduced by making the aeroplane an instrument of varied services, such as crop spraying and forest surveying. He expressed the hope that the Government of the Straits Settlements might consider the question as to whether Singapore could not be utilised effectively as an air junction between Europe, India, and Australia. Three important aspects of aviation were the provision of landing grounds, co-operation in meteorological work with a view to forming a common meteorological service, and the improvement of wireless facilities by the construction of new wireless stations. It was essential, he thought, that Imperial communications should be quickened, and there was no doubt that the modern aeroplane and eventually the modern airship would prove of great importance in any far-sighted policy of improvement.

Long Distance Flights.

DURING the past seven days three notable long-distance flights have been attempted or accomplished. At about 8 a.m. on Friday morning, May 20th, Captain Lindbergh left New York on a Ryan monoplane equipped with a 220 H.P. Wright "Whirlwind" engine. Flying continuously, he alighted at Le Bourget aerodrome near Paris at 10.30 p.m. on Saturday, May 21st, having accomplished the distance of 3500 miles in 33½ hours. It is understood that the machine alighted with about 50 gallons of petrol remaining in the tanks. Less successful were two British pilots, Flight-Lieutenants Carr and Gillman, who left Cranwell Aerodrome at 10.30 a.m. on Friday, May 20th, in an endeavour to fly non-stop to Karachi, India, on a Hawker "Horsley" bombing machine fitted with a 700 H.P. Rolls-Royce "Condor" engine. After flying for about 34 hours, the machine was forced to descend, apparently through lack of petrol, in the Persian Gulf, 45 miles south-east of Bandar Abbas. The machine was smashed, but the two officers were rescued unhurt by a passing steamer. The flight had covered about 3400 miles, and therefore very closely approached Captain Lindbergh's performance. On Monday of this week, May 23rd, the Italian airman, Colonel the Marquis de Pinedo, left Newfoundland on a Savoia flying boat for the Azores, the penultimate stage in a circular flight of 25,000 miles, which he began on February 13th. He was forced to descend on the sea as a result of the prevalence of a thick fog on Monday evening, after having accomplished nine-tenths of the projected flight of 1500 miles. His machine was picked up by a steamer and towed into Fayal.

The Ljungstrom Turbine Locomotive.

ON Friday of last week, May 20th, we had an opportunity of inspecting and running for a short trip on the Ljungstrom turbine locomotive, after it had brought, for the first time, the Manchester express to St. Pancras, due at 1.31 p.m., and before it took out the Manchester train leaving at 2.25 p.m. This engine, built by Beyer, Peacock and Co., Ltd., has been running for a short time between Manchester and Derby, and is now being tested on the Manchester and London service, for which purpose it has been lent or hired to the London, Midland and Scottish by its makers. Three crews from the railway company's staff have been trained to operate it, and from what we saw there would appear to be no difficulty experienced in handling it by a skilled driver, the controls, although different from the usual, being of a simple kind. Perhaps the chief difference to which the crews have to become accustomed is the closed-in cab, and the accompanying rather high temperature. The engine was illustrated and briefly described in our issue of January 7th. It consists briefly of two vehicles, one carrying the boiler and its accessories and the other the turbine and condenser. The turbine, of 2000 designed horse-power at 10,000 r.p.m., drives the leading axle of the motive vehicle through double-reduction helical gearing, into which an idler can be engaged for reversing purposes. Two other axles are coupled to the driving axle by external cranks and rods. We have as yet received no official information regarding the performance of the engine under service conditions. It can be said, however, that on Friday the Manchester express arrived only 4 minutes late, and that the lost time was entirely accounted for by signal checks on the run up.

Wages in the Engineering and Shipbuilding Trades.

ON Thursday of last week, May 19th, a special conference took place in London between the Engineering and Allied Employers' National Federation and the representatives of the various trade unions associated with the engineering industry. In reply to the demand of the unions for an all-round increase in wages, the employers repeated at first their offer of April, 1926, for an increase of 2s. 6d. per week, provided that concessions were made on the overtime and night shift rates. A counter proposal was submitted by the unions for an increase of 5s. a week to be conceded in two instalments, one on July 1st and one on September 1st. That proposal was not accepted by the employers, who again offered a conditional increase of 2s. 6d. per week, to take effect on July 1st, with the stipulation that the conditions and prospects of the trade would be reviewed again in July, 1928. Alternatively the employers offered a special advance of 2s. per week to plain time workers from August 1st on the understanding that wages would remain undisturbed for twelve months from that date. The trade union representatives, while declining to accept either the offer or the alternative, suggested that an unconditional offer of 2s. 6d. per week should be made, and that wages should again be reviewed in six months' time. After the employers had intimated that they were unable to add either to the offer or to the alternative, the conference was concluded, no basis for an agreement being found. A conference of the union executives will be called to consider the position. The following day, Friday, the 20th inst., a preliminary conference was held in London between the Shipbuilding Employers' Federation and the representatives of the various shipyard unions which are embraced in the Federation of Engineering and Shipbuilding Trades. The claim of the unions for an advance of 10s. per week in the wages of shipyard workers and a proportionate increase in the wages of pieceworkers was argued, and after two hours' discussion it was agreed to adjourn the conference to give the employers an opportunity of considering the statements made and of meeting representatives of certain other unions who have put forward a claim for an increase independently of the Federation.

The Generation of Electricity in Great Britain.

THE analyses and summaries of the returns made to the Electricity Commissioners of the units generated and the fuel consumed at generating stations in Great Britain during the year ending March 31st, 1926, have been prepared in a more comprehensive form than those hitherto published. In previous years particulars of the technical working results of individual generating stations were confined to those stations which showed the lowest average consumption of fuel per unit generated, and the highest thermal efficiency, but with a view to increasing the utility of the return a complete list is given in the present case of all the generating stations for which records were received during the year, and also in the majority of cases a summary of the technical results of working. In some instances, however, it has only been possible to give partial information, whilst in the case of certain generating stations not belonging to authorised undertakers, the voluntary returns were submitted by the owners on the understanding that certain of the details would be used for the purpose of aggregate figures only. Of the 584 stations dealt with, the returns submitted enable the technical results of operation to be determined in 454 cases, although for the reasons indicated some of the results are not included in the table dealing with individual generating stations. The remaining 130 stations consisted of stations permanently closed down before the end of the year or maintained in partial operation during the year, stations in which the entire output was generated by waste heat, town's gas or water power, and stations in which a large proportion of the output was generated by waste heat, &c., or where no useful records were available. The total number of units generated at the 584 stations during the year under review was 8,122,961,823, representing an increase, as compared with the previous year, of over 707 million units, or 9·5 per cent. The corresponding consumption of coal, coke and oil fuel, namely, 8,445,566 tons, showed an increase of 403,324 tons, or 5 per cent.

The Continuous Nature of Decay in Dams.

By WILLIAM HARVEY.

In recent times dams of very various types have collapsed and produced devastating floods, sometimes attended with loss of life, and always with considerable loss of property.

Notwithstanding these disasters, the demand for new dams continues to increase as water power is introduced to supply the place of coal in the production of electricity, and as populations increase in numbers and in their requirement of larger allowances of water supply. Dam building is likely to become more and more familiar in the near future, and many new dams of experimental design are already either just completed or just about to be built. Under these conditions, a review of the nature of decay in dams may assist the surveyor to recognise the symptoms of danger in time to suggest the provision of adequate repairs to an existing structure, or may help the designer of a new dam so to plan his work that repairs will not be necessary for long periods.

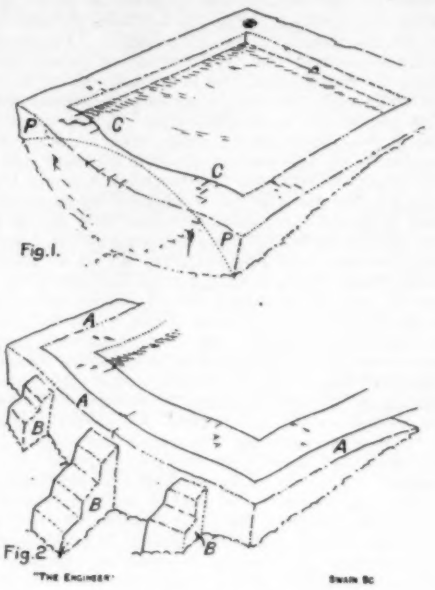
The rival claims of safety and of economy in first cost demand that new designs and repairs and additions to old works should be carried out in the fullest knowledge of the possibilities of decay if doubtful expedients and costly failures are to be avoided. As things stand, the temptation to economise in the cost of construction introduces an element of uncertainty which is highly unsatisfactory, and it is only as cheaply built dams decay and fail that their lack of permanent stability will make itself known, unless an impartial scientific inquiry can be directed upon the subject of dam design. Practical experience, as well as theory, must be applied to the subject. Scientific design by calculation of pressures facilitates the reduction of section by permitting the proper placing of material, but, under modern conditions of design in the office, some of the aspects of dam design which are familiar to primitive constructors are in danger of being ignored. A statical diagram necessarily presents only an instantaneous view of the conditions of stability, and yet the decay preliminary to the failure of a dam is not necessarily instantaneous.

Ancient dams, such as those which still serve to retain water in the so-called "Pools of Solomon" near Bethlehem, show, by the addition of blanket walls and buttressing masses at different periods, that their partial failure has been sufficiently marked to suggest that repairs were necessary, yet slow enough to permit of rough, but passably efficient repairs being brought to bear upon the work. These dams, and a great number or vertical walled dams in southern Spain, have been designed without scientific calculation or adjustment of the wall section to the pressures, yet they often survive from the distant past, whereas recently constructed dams have collapsed suddenly without warning within a few years of their erection. The comparatively small size of most of these primitive dams erected by persons familiar with dam design by tradition and experience, has undoubtedly contributed to their long-continued preservation, though the walls of Solomon's Pools are of respectable size and range from 25ft. to 48ft. in height. The recognition that repairs and additions are necessary from time to time, and the practical vigilance with which the inhabitants of a dry country watch over their essential water supply provides another safeguard without which these primitive works would have perished centuries since.

This modest outlook, expecting to have the work fail and then standing on guard to save it before it falls, may be construed as an admission of inept design and feeble construction, which should not be necessary in connection with well-constructed and properly calculated modern works. But there is another and better ground for continual vigilance in that the Oriental dam builder recognises a principle of continuity in the application of the water pressure and its cumulative effects on the masonry. While the water "never sleeps," but follows up every defect and movement with renewed application of pressure, the materials of the wall are continually retreating to positions of greater insecurity from which it will be more and more easy for the water to dislodge them. The fluent curves of contrary flexure assumed by the plans of most of these primitive works have been produced in the course of years as yielding of the dam followed the application of pressure, and was followed in turn by the re-application of pressure to the weakened material.

As a great many such dams are of little length, it often happens that the work is held, more or less precariously, in a bulged and leaning position by the aid of the lateral continuity of the bonded masonry, as in Palestine, or by the tenacity of the mortar, as in Spain. The dam has definitely failed as a "gravity" dam, since the resultant pressure at the base of the wall is violently excentric, and would overturn it; but it has been preserved for the time being as a beam slab, of considerable thickness, if of feeble tensile strength, enclosed and supported, if not "fixed," on three edges, though free on the fourth or wall top—see Figs. 1 and 2, which show primitive vertical-wall dams bulging and cracking, but sufficiently stable to allow of added material being applied in blanket walls at A A A and in buttresses at B B B.

The well-known case of failure of the masonry dam at Bouzéy, in France, on the water pressure being applied, showed how a modern dam could fail in very much the same manner as one of primitive design. The section of the dam approached more nearly to the Oriental type of parallel-sided wall than was consistent with the retention of the line of pressure within the middle third of the base, and the initial failure of the dam was such as is usual in connection with primitive vertical wall dams. As the water level rose to about 10ft. from the proposed water line, the structure bulged out in a curve some 400ft. in length, with a maximum deflection of 1ft., with cracks at the convex points of curvature. Two million gallons escaped in twenty-four hours, and the pressure



FIGS. 1 AND 2

was relieved. As in Oriental cases, the bulging was accepted as a sign that repairs were needed, and a long continuous buttress apron was added at the base on the downstream side of the dam. Fig. 3 gives the outline of the section of the Bouzéy dam after the addition of aprons at A A A, which did not prevent failure on line B B.

The cracks were stopped up with wooden blocks steeped in tar, and the water was allowed to rise again in the reservoir some five years after the original completion of the dam.

The work was accepted as sufficiently sound for practical purposes during the succeeding five years, although leakage took place in the winters, when the lower temperatures allowed of contraction taking place in the masonry. In 1895 the central part of the dam was washed out from the level of the top of the continuous buttress to the wall top in such a sudden and unexpected manner that a disaster followed the violent escape of the water. After the event, it was realised that the fissures on the upstream side of the dam had allowed water to penetrate into the mass of the masonry, and exert a lifting force which still further reduced the stability of the dam and prepared it for its fall. Even after this experience, some engineers have been optimistic enough to advocate the designing of dams with the line of pressure falling outside the middle third of the base, in the interests of economy in first cost, though most designers of "gravity" dams are now agreed that the resultant pressure of water and wall combined should come within the middle third.

The feature of this failure, which seems to have escaped attention, is that, during the years which intervened between the first partial failure and its repair, and the disastrous collapse of the dam, no person seems to have comprehended that there was trouble brewing. The excessive leakage in winter was ascribed to the effects of contraction cracks, and the gradual widening of these cracks and their structural significance were alike ignored. It is difficult to look back over the history of the two failures and yet suppose that the second important and disastrous break took place without some preliminary movements and bulges which should have given warning that all was not well.

The Oriental idea that the unsleeping water is likely to circumvent human efforts, and that the utmost vigilance will be needed to keep it within bounds, is really applicable to all dams, however scientifically designed; though it comes more obviously before the notice of the practical dam builder in a country where field irrigation is practised, than to the mathematician who works out pressures in decimals of a ton in a laboratory, and is handicapped by the knowledge of his own precision of calculation.

It is not that the calculations are incorrect, but that they are incomplete, in that they take no account of the effect of time and of the inevitable movements which must weaken the dam, while they permit the water pressures to attain to a more damaging point of application. The lumbering and unscientific dam of primitive type with equal, or almost equal, thickness at top and bottom, may, and generally does, exhibit very obvious signs of failure by excessive bulging before its collapse, for its beam slab action comes to the rescue of its incapacity as a gravity dam. Such large and obvious bulges must not be expected before the collapse of a more economic and more scientifically designed structure, which has practically no power of acting as a continuous beam after its initial failure. But there must certainly be some preliminary deflections, even though they be but microscopic, and public safety demands that these symptoms, however minute, should be impartially studied. It is quite possible that in the case of the Bouzéy dam small deflections were observed, but were treated as insignificant effects of temperature change or initial settlement, when in reality they had occurred in response to overturning pressures, though they may have been aggravated perhaps by such other contributory causes. The modern engineer, too, probably does not share the Oriental's tradition as to the inevitability of movement, and would keep silence concerning evidences which he might feel derogatory to his professional credit, while hoping against hope that they would not prove to be correct prognostications of actual disaster.

Once it is understood that decay in dams is naturally and cumulatively progressive, such dangerous secrecy will lose its motive and object, and it will be a point of professional interest to discuss the scientific evidences of decay in such structures on an impersonal basis.

While dams of primitive type or of intermediate character such as that at Bouzéy, with the line of resultant pressure outside the middle third of the base, may be expected to fail more rapidly than those which have the section more perfectly adapted to the pressure, there is no actual possibility of permanent stability without repair even in the best of cases. Alterations in water level imply fluctuations in the magnitude and position of the line of resultant pressures and consequent rocking of the wall on its founda-

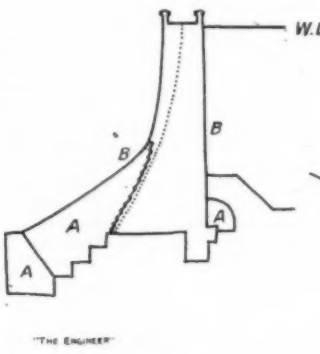


FIG. 3

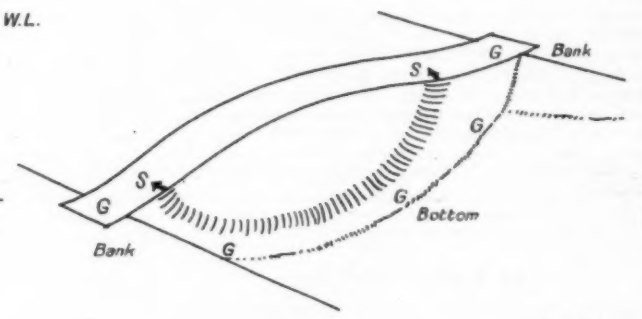


FIG. 4

tions, or of parts of the wall on some appropriate bed joint. Such rockings produce cracks which will be opened wider by shrinkage of material, owing to decrease of temperature or by compression and packing or settlement under the points subjected to maximum stresses. The augmentation of lifting pressures due to water penetration, with its pernicious cycle of yieldings of material and increasing damage, then follows with failure of the dam impending at some time in the future, though a well-considered design naturally implies the longest duration.

While the nature of the lateral water pressure makes it impossible to avoid failure at the end of a sufficient period of years, the inequalities of the resistance offered by different parts of the dam control the positions at which fractures will take place. Granted fairly equal strength of material throughout the length, the hold of the abutments at the ends of the dam will maintain the adjacent parts comparatively steady, while water pressure is tending to overturn

the centre portion of the dam, and is causing it to bulge down stream. The dam as a whole is by this action subjected to torsion, and is liable to have its central upper portion sheared out by cracks which occur on the upstream side of the dam along a convex curve which borders the bulging portion, and separates it from the comparatively stable masonry at the ends and bottom of the dam—see Fig. 4, in which S S shows the line of special weakness and G G the stable portions.

Each type of dam has its own particular line of greatest probablity of shearing, but the torsion which produces the bulging is common to all, and the line of convex curvature may be anticipated for any special design and confirmed by tests conducted with models.

The great thickness of primitive dams reduces the liability to fail quickly by shearing, by diffusing the curvature of the bulging portion of the dam, whereas the thin top and less plastic material of a modern dam favour abrupt fracture before bulging has proceeded to any great lengths.

The attempt to avoid bulging in a downstream direction by giving the dam a curved plan and an arch-like character against the water pressure, would probably be phenomenally successful, if ample quantities of sound material were used in the work; but the possibility of additional strength is sometimes discounted beforehand by making the dam thinner in order to complete its long curving line with no more, or even less, material than would be needed to build a dam in the shorter straight line from abutment to abutment. But the possibility of failure by distortion of the arch by flattening at the crown is not a remote one. For although it is sometimes accepted that the water pressures are equal on all parts of the extrados of the arch, that is an optimistic assumption which ignores the application of waves near the summit of the dam in times of flood and

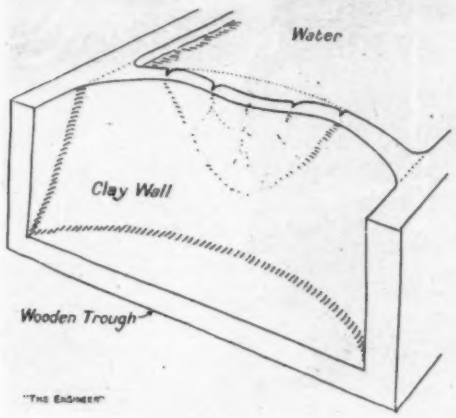


FIG. 5

storm, just when conditions are most unfavourable to stability.

What is even more favourable to distortion of the arch and dislodgement of its crown is the fact that, even if the water pressures act in lines normal to the extrados of the arch with equal force on every unit at any particular depth, the resistance of the material of construction is not equal in all parts of the arch ring. Each arch dam, and every arch in a multiple arch dam, is not a complete vertical cylinder subjected to, and supported by, equal water pressures all round its circumference, but is a portion only of a cylinder depending for its stability upon the buttressing effect of abutments at the end of the dam or of specially constructed supports between the several arches of the series in a multiple arch design. Greater stiffness at the junction of the arch with its abutments than at its crown will be the normal condition of things, and unless enormous excess of material is used to keep down the intensity of the stresses with a high factor of safety, the arch will be sensitive to its own inequality of rigidity in different parts, and will suffer distortion of a nature directly referable to this inequality of resistance.

A model made of clay to emphasise the excellent qualities of the horizontal arch type of design afforded a warning as to these additional possibilities of failure. Two equal weights of clay were taken and modelled into two dams near the ends of a parallel-sided trough, one dam being straight in plan and the other curved. Water was then poured into the trough to fill the space contained between the two dams in such a manner that each was submerged equally to within ¼in. from its top. The model was kept under observation for several days before any noticeable deflection or disintegration took place; but, after a week, the summits of the dams were found to be bowing out and the thinner wall of the curved dam was suffering more than the other. Water saturation of the upper part of the wall caused the curved dam to break up in the course of the next few days, and the experiment brought itself to an end with its collapse. The straight model dam had in the meantime also become saturated, and was only prevented from disintegrating by its somewhat greater thickness of material. Fig. 5 was drawn when the model dam had begun to bend, but before any material had fallen away. Very much more refined tests could be put in hand with scale models composed of different materials, and the economy and efficiency of the various types of dam demonstrated.

From the experiment above mentioned it would seem to be clear that dams are liable to progressive decay by slow and almost imperceptible stages, and that the rate of decay is accelerated as the collapsing point draws near. The final fall either of the model or of the full-size dam is practically instantaneous.

With reference to the merits of the dam which is curved in plan, a single experiment is necessarily inconclusive, though the pernicious effect of undue economy of material in permitting distortion at the crown of the arch and encouraging final disintegration is demonstrated very clearly.

In a dam composed of a single wall curved in plan, the torsion of the dam is resisted to some extent by the arch action as long as the arch is free from disintegration and is capable of acting as a coherent structural unit from abutment to abutment. The multiple arch type of design possesses no such advantages. The tendency to torsion in the dam is just as great with this type of design as with any other, and its resistance to disintegration under the action of torsion is not at all promising.

A long series of equal arches with equal abutments between each pair of arches does not do justice to the fact that some arch or arches near the shores of the reservoir and the ends of the dam will be called upon to withstand a most destructive pull and twist from the central group of arches as they tend to deflect more freely in the downstream direction—see Fig. 6, where the shoreward arches are shown cracked by the pull of the central group of arches as they yield in a downstream direction.

Much more complete provision ought to be made for the adequate lateral connection of the arches of

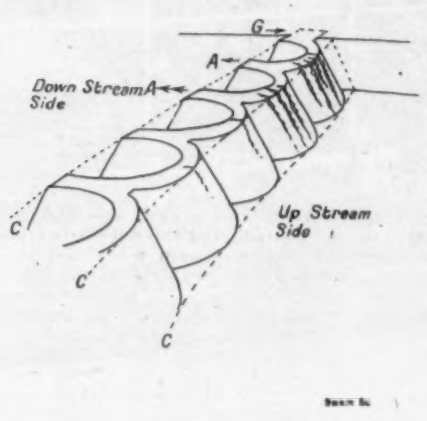


FIG. 6

the series than has been made in some existing dams of this type, and, as a matter of general principle in dam design, this subject of lateral continuity deserves far more consideration than has been given to it hitherto.

If it be accepted that the decay of dams and retaining walls is brought about by a succession of progressive movements—and experience in connection with both full-size buildings and with models leaves no room for doubt on this head—it should be possible to formulate some rules for design and for practice which will do something to promote the construction and maintenance of dams of a more enduring and less dangerous character than have been in use up to the present.

The prospect of progressive movement in the central portions of a dam makes it very desirable that the resultant line of pressure should be brought as near to the effective centre of the wall at every stage of its height as is practically possible. The "middle third" theory is only a convenient rule of thumb, which has had fair results in the past when stresses have not been too intense, but it is not founded upon any principle of mechanics. All excentricity of loading is liable to be productive of rocking in the wall, especially as the work grows older and as penetration by water sets up lifting pressures. Great height and intense stresses make a small excentricity in the application of pressures in a long and high dam more dangerous than a somewhat greater excentricity of application of pressures in a low and small dam where the light stresses are resisted by foundations and materials of construction equally as strong as those of the large dam. If the upward reaction of the foundation takes a line passing through the centre point of the base, absolutely permanent stability can only be obtained by so designing the dam that the resultant line of pressures takes the same line as the reaction of the foundation. There is no magical spot situated at a distance of one-third of the thickness of the wall from its downstream edge at which "positive safety" is sharply divided off from "certain danger." The nearer the resultant is to the line of the upward reaction, the more effectively will they neutralise one another, and the less powerful will be the "couple" they constitute if they fail to meet. The subject has been complicated by the unknown factor of lateral tenacity in the dam, and the pernicious effects of excentric loading have not been fully recognised. The knowledge that movements are progressive also emphasises the importance of lateral connection and continuity throughout the structure of the dam to resist torsion and the shearing out of its central masses. The points of convex curvature on the upstream side of the dam near to the points of contrary flexure in the line of the dam after it has bulged, are the points of weakness, and if they can be ascertained in advance and given strength in proportion to the shearing and tensile stresses which will come upon them, many years may be added to the endurance of the dam.

The knowledge that decay is cumulative would also lead to the adoption of ample masses of material in dams of arch shape in plan in order to avoid the possibility of distortion in the line of the arch curve and consequent dislocation of its voussoirs, or portions of material, if the arch is not composed of definite voussoirs. Recognition of the liability to continuous minute movements would probably rule out the multiple arch type of design as unsuitable and dangerous, unless its arches and buttresses were to be hidden and enclosed in a tubular sheath of heavily reinforced material to supply the longitudinal connection that is so conspicuously absent in cases in which the separate arch cells are left open at the top and on the downstream side of the dam.

Once a dam is completed, its movements should be kept under observation and made the subject of periodic reports. The plan of the dam with all deflections marked and the positions of all fractures indicated would be filed for reference, and would be available for comparison with the movements charted in other years and with the movements in other dams of the same or different types. Particulars as to the head of water between the time of one report and the next, weather conditions, and the amount of seepage should be recorded on the movement chart.

All large dams, new or old, should be provided with rows of accurately levelled gun-metal plugs and rigidly fixed telescopic sighting gear, by means of which the slightest departures from level or alignment may be surveyed and recorded. In this way the structural meaning of what are popularly known as "temperature cracks," "expansion cracks," or "contraction cracks," would be realised more clearly than is possible at present, and these somewhat too optimistic terms would probably be replaced by others having more direct reference to the progressive disintegration of the masses which precedes failure of the dam. If these reports were to be accompanied by the use of experimental models, an accurate science would be built up to replace the dangerous partial knowledge which now leads to rash experiment on a large scale and the terrific failures of public works which should be made so as to be permanently serviceable, even though timely repairs have to be counted upon to meet the effects of progressive movement.

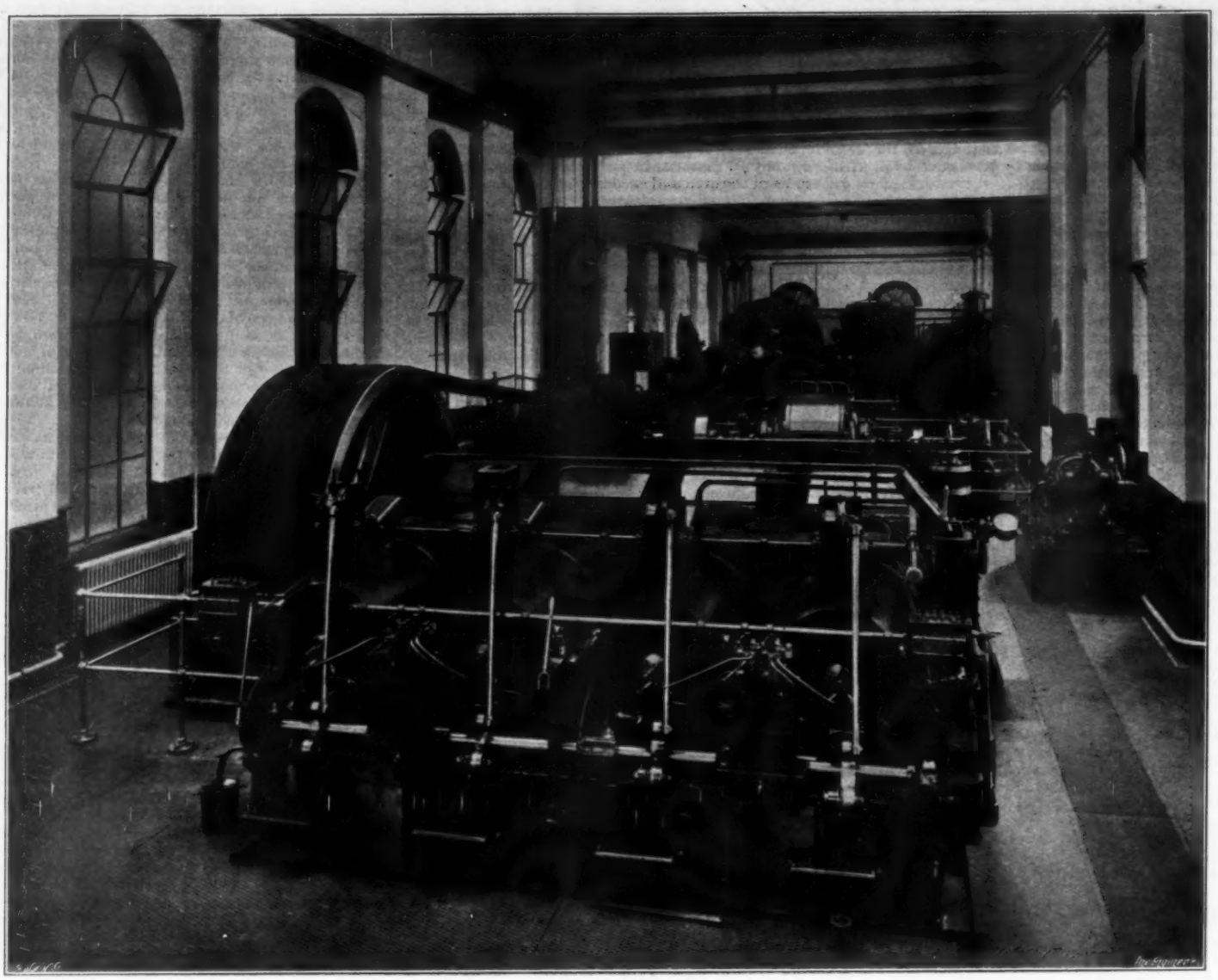
Oil-Engine-Driven Pumping Plant at Epsom Waterworks.

THE Epsom Urban District Council water supply undertaking is of historical interest, for the site of its East-street waterworks, at which oil-engine-driven pumping machinery has recently been installed, dates back to the year 1851, when the first artesian well, with a 4in. copper tube, was sunk. The site was acquired by the Local Board of Health for Epsom in 1853, and a pump worked by a 20 H.P. steam engine was put to work. In 1854 the Epsom waterworks were opened, and at the present works a dated valve cover of that year is now to be seen. The old beam engine was superseded in 1895 by a 48 H.P. steam pumping plant of Worthington make, which was designed to lift 416 gallons of water per minute, and in 1907 that plant was again followed by a gas-engine-driven set which comprises a 150 B.H.P. Crossley gas engine, driving a double-throw Worthington-Simpson bucket-type pump through a double worm drive. It is designed to lift 833 gallons of water per minute against a total head of 375ft., the depth of the well being 90ft. That plant is still in operation. In 1915 it was supplemented by a combined well and surface pump of Worthington-Simpson design, electrically driven from a 130 B.H.P. direct-current motor. These pumps are designed to deliver 1000 gallons of water per minute from the well into the reservoir against a total head of 410ft. when drawing the water from the same well as the gas-engine-driven plant. The two latter plants are to be seen in the background of the view at the top of page 570.

THE NEW PLANT.

The newly erected pumping plant, which was officially put to work on Saturday afternoon, March 5th, comprises a 400 B.H.P. four-cylinder Crossley-Premier oil engine, which drives, by means of ropes, a Worthington-Simpson 12in. four-stage high-lift turbine pump geared to a 12in. two-stage vertical high-lift turbine pump. The arrangement of the new machinery room is shown in Fig. 1, page 570. From this illustration it will be noted that ample space has been

EPSOM WATERWORKS—INTERIOR VIEW OF PUMP-ROOM



given around the plant, and, as shown above, a 10-ton overhead crane by Herbert Morris, Ltd., of Loughborough, is provided for lifting purposes. The new pump and engine-room, which adjoins the old engine-room, was constructed by Messrs. Cropley Brothers, of Epsom. It is well lighted and is tiled in a pleasing manner, chequer plated gratings being provided in the floor to give access to pipe connections and parts of the engine and pump which require periodical inspection. The main drive consists of twenty-four ropes, each 1in. in diameter, and suitable hand rails and rope guards are fitted. Outside the building are arranged two of the old Lancashire boilers, which were formerly required for the steam pumping plant, but are now placed on end and serve as fuel storage tanks. They are mounted directly over the silencer pits, so that full advantage is taken of the heat of the exhaust gases for warming the oil fuel. Heating is effected by the circulation of hot air through what were the furnace tubes. After leaving the silencers the exhaust is carried away to a brick uptake. Alongside the engine are the ready-use storage tanks. The fuel is delivered to the storage tanks through a 2in. Beck type meter and between the storage tanks and the ready-use tanks, a 1in. meter of the same pattern is fitted. The fuel generally employed is Diesel oil of the standard quality, with a specific gravity of 0·91, and a heating value of 18,000 B.Th.U. per lb., but furnace oils have been successfully used over long periods. In what follows a general description of the engine is given.

THE OIL ENGINE.

The view reproduced at the top of the page was taken from one end of the engine and pump-room, and from it a general idea of the appearance of the 400 B.H.P. Crossley-Premier oil engine can be obtained. The engine is of the latest pattern, and is the product of The Premier Gas Engine Company, Ltd., of Sandicare, near Nottingham, associated with Crossley Brothers, Ltd., of Openshaw, Manchester, who were the main contractors for the engine and pumps. The accompanying drawings—Figs. 2 to 4—illustrate clearly the principal features of the engine, which is a four-cylinder unit, with a designed output of 400 B.H.P. at a normal speed of 214 r.p.m. The cylinders each have a bore of 16in., with a stroke of 26in. As will be seen from the sectional elevation—Fig. 2—the bed-plate is of the box pattern, which is heavily ribbed and is cast in a single piece. A noteworthy feature of the crank-pit arrangement is the provision of a special oil sump for the used piston-lubricating oil, which is thus kept quite separate from the oil supplied to and used by the main bearings and big ends. The main bearings—five in number—have cast iron shells which are white metal lined, and outside the fly-wheel an outboard bearing of the self-adjusting and self-lubricating type is provided. The water jacket casting carries the four cylinder liners. It is attached to the main bed-plate by a broad flange and is supported below on cast iron stools. The liner and the breech end of the cylinder forms one casting, so that the usual joint between the liner and the breech end piece, which often gives trouble, is entirely dispensed with. We may remark on the spherical end of the liner and the well arranged valve space beyond it, with the central spray valve. The head of the liner is well ribbed to the breech end casting, and is thus strengthened to withstand the combustion and heat stresses. Owing to the length of the distance between the spray valve and the piston head the head of the piston is not subject to direct flame action, and a very cool-running piston is thus obtained. At the back end of the cylinder a circular plate closes the water spaces, which, when removed, gives full access to all parts of the cylinder water

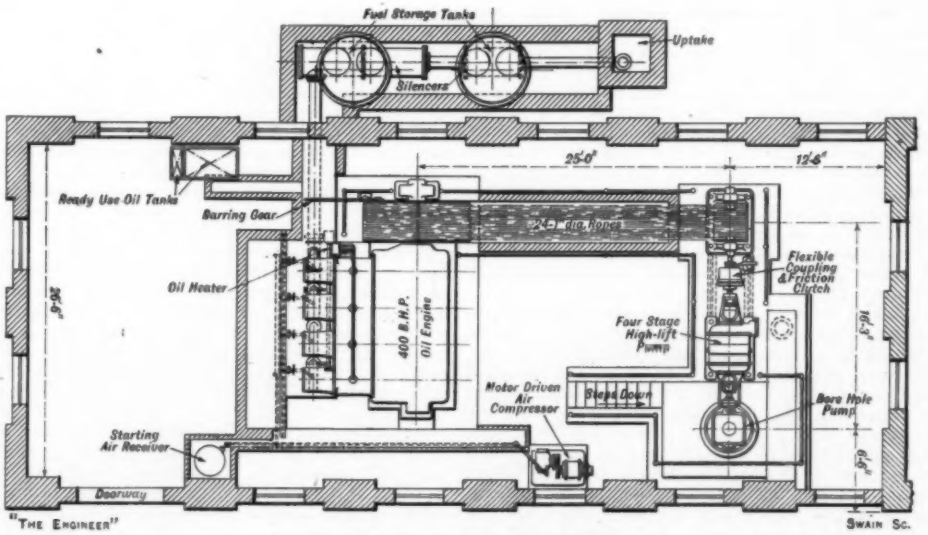


FIG. 1—PLAN OF PUMP-ROOM EXTENSION

space. The drawing—Fig. 2—shows the large cooling spaces which are provided in the region of the cylinder heads and valves. The piston is fitted with seven rings and the upper part of the head is strongly ribbed internally. The crosshead pin is placed well down the piston skirt and the small end of the connecting-rod is of the split marine type. It is made in gun-metal and the small end bolts are conveniently reached from the end of the piston. The large end bearing is cast steel fitted with a white metal lining. A solid-forged crank shaft, large in its proportions, is provided, and in accordance with usual practice it is drilled for the crank pin lubrication, the oil from the lubricating pump being delivered by oil rings fastened to the crank cheek. Hinged oil guards of planished steel entirely cover the crank pits, and these may be thrown back on to supporting castings

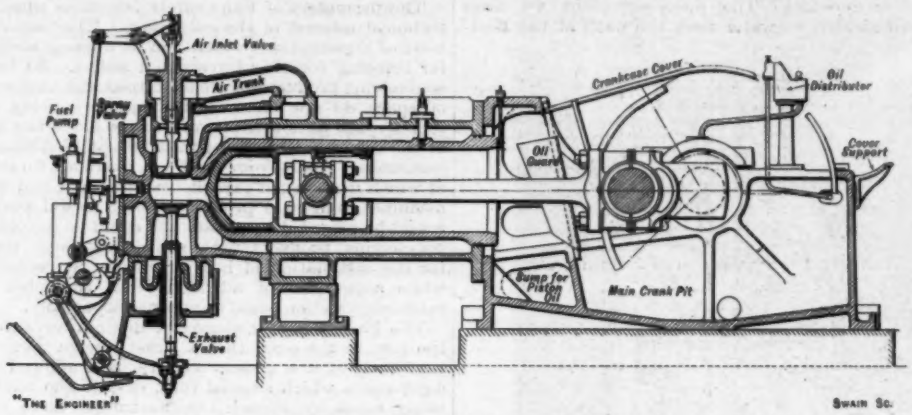


FIG. 2—LONGITUDINAL SECTION THROUGH ENGINE

mounted on the bed-plate. After a further sliding oil guard in front of the liner end is lifted, the whole of the crank case is open to inspection, as well as the connecting-rods and the piston ends.

Turning to the valve gears, some interesting points in design may be noted. The air inlet and exhaust valves are mounted one directly above the other at the back end of the cylinder. By taking the air through louvred silencing boxes, and around the cylinder jacket spaces, quiet entrainment is obtained. The air inlet valves are carried in cast iron cages which are jointed metal to metal with the breech end casting. The valve cover carries the fulcrum bracket for the valve lever, which is worked from the cam by a push rod. When the inlet valve is removed, the exhaust valve can be taken out from the top of the cylinder. This valve has a hollow steel shank with

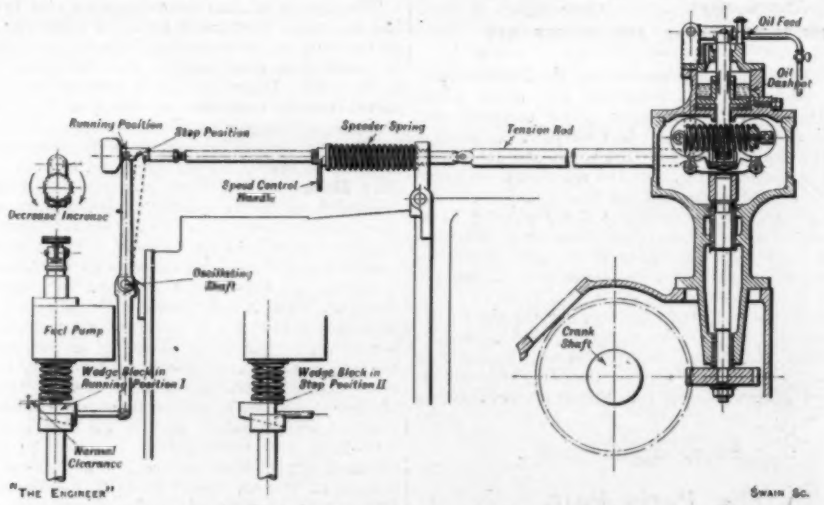


FIG. 3—ARRANGEMENT OF FUEL PUMP AND GOVERNOR

a special cast iron head and water cooling may be fitted if desired. It will be noticed from the drawing that the spindle bushes extend beyond the bush supporting castings, and are covered by shields attached to the valve spindles, so that the steel spindles are not harmed by the downward current of hot exhaust gases. The bushes are drilled for lubrication, and a connection is made to the mechanical lubricators seen at the extreme right and left of the engine cylinders on page 570. The oil so delivered serves both to lubricate the spindles and also to make them gas-tight. The casings in which the exhaust valve bushes are fixed are square in section, with large inspection doors, giving access to the water spaces. One of these doors carries the fulcrum support for the exhaust valve lever, and also a light steel oil tray. The fulcrum pin is fixed in the valve lever and works in gun-metal bearings, one on each side of the lever. On the upper end of the lever there is a broad steel roller, which works on a sliding bush and can, by the cam lever provided, be moved over to engage with the narrow half compression cam during the operation of starting the engine. It will be noted from our illustration that there are two valve springs on both the inlet and exhaust valves, and ingenious attachments are fitted which enable the attendant to remove and replace any spring whilst the engine is in operation.

The arrangement of the fuel pumps and sprayer valves is shown in Fig. 2. The pumps are grouped in two pairs and are mounted directly over the back cam shaft, which is driven by gearing from the crank shaft through a side shaft. All the gears work in oil baths, so that silent operation may be obtained. The arrangement is such that the fuel cams which are adjustably secured to a disc keyed on to the cam shaft, work the fuel pump plungers by means of rollers fitted to a swinging lever. These levers, in turn, press against a guided sliding piece, so that at the plunger a direct central thrust is obtained. Each pump is provided with two suction valves, and two delivery valves. Hand priming levers are also fitted to all the fuel pumps. The amount of fuel which is actually delivered to the cylinder is determined by a mechanically-operated by-pass valve, which is wedge-controlled by the governor. The method of control is illustrated by Fig. 3. From the high-speed governor which is direct-driven from the crank shaft, a tension rod is carried along the side of the engine, and operates by a downcoming arm an oscillating shaft, which runs parallel to and above the cam shaft. Attached to this shaft are four further levers, which, in turn, are connected to the wedge blocks interposed between the driving pieces and the stems of the by-pass control valves.

In position I, which is the normal full-load position, there is a clearance at the wedge which becomes less as the governor rises and pushes the wedge further in, thus opening the by-pass valve earlier, and reducing the oil charge delivered to the cylinder. On the tension rod is an adjustable speeder spring, and near its end are two notches which engage with a pin in the top of the lever, which works the oscillating shaft. A bob weight is provided at the end of the tension rod.

When desiring to shut down, all that is required is to lift the bob weight, and transfer the pin to the other notch, which brings the wedge into position II; that is, with no clearance, so that the by-pass valve begins to move at the same time as the pump plunger, and the whole charge is by-passed into the suction pipe and none delivered to the sprayers.

Hand-operated by-pass valves fitted to the sprayers can also effect this same purpose.

Another point of interest connected with the engine is the main bearing lubricating arrangement which is illustrated in Fig. 4. Oil is delivered to the main bearings by an oscillating valveless pump, which is driven from the side shaft already referred to. The pump draws its supply from an oil tank immediately below it, and delivers oil into a pipe system supplying the oil-distributing boxes, which are mounted on a pedestal well above the main bearings. The delivery is effected through needle valves which are adjustable, and a glass cover enables the oil supply streams to be clearly seen. The discharge pipes reach nearly to the top of the oil box, and oil is delivered to them through syphon wicks, which serve to intercept any grit or dust and at the same time, in the event of the oil supply from the pump ceasing, will lubricate the bearings for a considerable time from the supply of oil already contained in the distribution boxes. Visible oil feeds are arranged for each of the main bearings, and for the governor, and also for each of the crank pins. The oil which is drained from the crank pit passes out into one of two filters, either of which

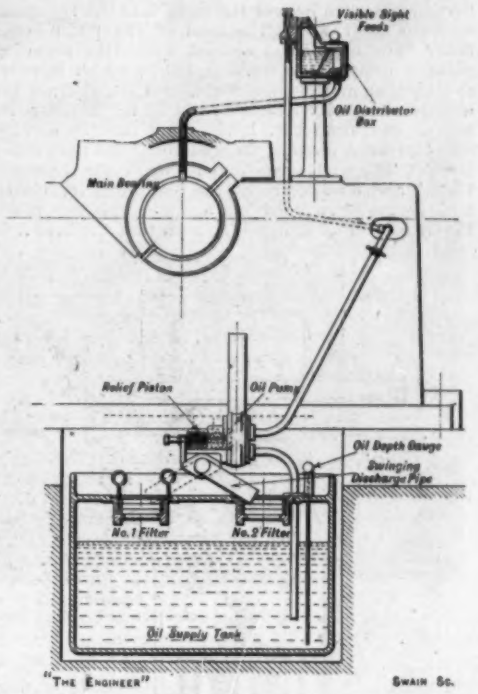


FIG. 4—MAIN BEARING LUBRICATING ARRANGEMENT

can be served by a swinging discharge pipe, enabling one to be cleaned while the other is in operation. The pump, as will be seen from drawing, Fig. 4, is provided with a small cylinder containing a spring-loaded piston which helps to maintain a constant pressure of lubricating oil in the system supplying the sight-feed lubricators, by opening a port in the cylinder and by-passing oil back to the storage tank when the pressure rises above the desired amount. We have already referred to the two mechanically-operated lubricators which supply oil to the pistons, the small ends and the spindles of the exhaust valves.

Compressed air at a pressure of 250 lb. per square inch serves to start the engine. The air is supplied by an electrically-driven drum-type Reavell com-

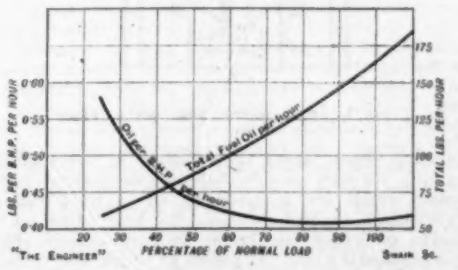


FIG. 5—FUEL CONSUMPTION CURVES

pressor, which delivers air to the starting receiver placed near the back of the engine. Two of the cylinders are fitted with check valves, and are connected by air pipes to a cam-operated distributing valve and stop valve, which latter is opened and closed by the starting handle. The starting position is indicated by marks on the cam shaft bracket, and a pointer on the cam shaft, which enables the engine to be barred round into the correct starting position. When compressed air is admitted to the cylinder, the engine starts and quickly takes up on fuel. A fuel oil filter and heater is provided on the engine, and through it the warm circulating water from the cylinder jackets passes. The two filters are provided with a change-over valve, so that either filter can be removed and cleaned without having to stop the engine.

In the accompanying curves—Fig. 5—we show fuel oil in pounds per B.H.P.-hour and also the total fuel oil used per hour plotted on a base of percentage load. The lubricating oil used by the engine works out according to tests which have been made at about 0·001 lb. per B.H.P.-hour, but with the special lubricating devices we have described, part of this oil is available for make up. When inspecting the

plant, we noted the ease and certainty with which the engine was started, and the silent and steady running of the engine and pumps. Like similar Crossley-Premier oil engines which are now being built, the unit is capable of being quickly adapted to work as a gas engine, when a few minor alterations have been made. This is a possible advantage to the users, as gas producer plant is already installed for the gas-engine-driven pumps. On the other hand, with the present prices and supplies of oil fuel, it is not likely that gas will be employed.

Pumping Machinery.

The pumps were supplied by Worthington-Simpson, Ltd., of London and Newark, and the plant is designed to raise 2000 gallons of water per minute from the bore-hole and to deliver the same into the reservoir, which is 266ft. above the level of the pump-house floor. The total head against which the pumping plant is designed to work is 420ft., which includes the friction in the pipe main, and the suction lift and the pumps have an efficiency of 70 per cent. As will be seen from Fig. 1, the plant may be divided into two parts, namely, the well pump and the surface pump. The well pump and its drive are shown in Figs. 7 and 6 respectively, the pump and its suction box being reproduced on a slightly larger scale. Referring to Fig. 6, it will be seen that the bore-hole

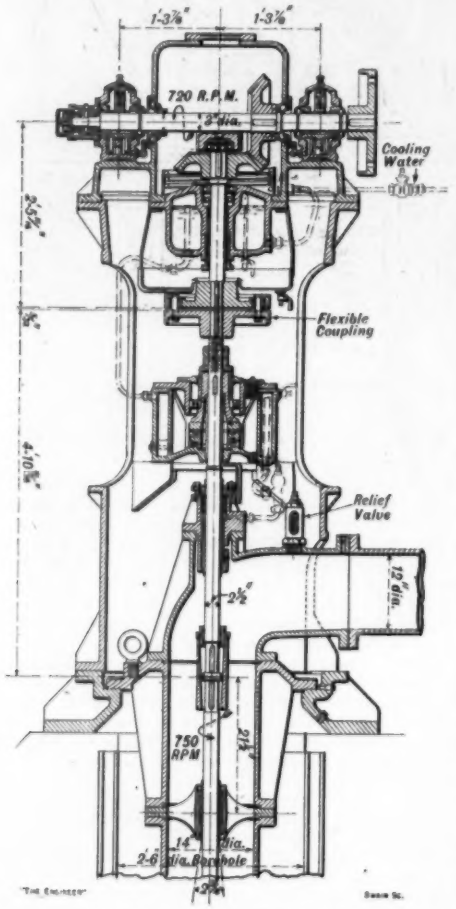


FIG. 6—GEAR DRIVE FOR WELL PUMP

pump is driven from the coupling of the high-lift pumps, through double helical machine-cut bevel gears, which are enclosed in an oil-tight casing. Provision is made for cooling the lubricating oil by means of water circulation through copper tubes immersed in the oil. At points at which the vertical shaft passes through bearings it is fitted with gun-metal sleeves and the bearings are lubricated by water in spirally arranged grooves. A three-plate thrust bearing fitted with alternative lubrication and water cooling is also provided. The pump and vertical shaft run at a speed of 750 r.p.m.

The rising main is 14in. in diameter, and it is directly connected to the 12in. suction main of the four-stage high-lift turbine pump, which runs at a speed of 720 R.P.M. This pump has four gun-metal impellers, which are fitted with separate diffusion rings. As the two pumps are connected one to the other, the unit is self-regulating as regards the power which is taken by each pump. Between the rope-driven pulley and the high-lift turbine pump a flexible coupling and a clutch of the Cooper type, which allows the engine to be started independently of the pump, are fitted. Normally, however, the pumps are started with the engine, and the clutch is not required.

Engine and Pump Tests.

By the courtesy of the consulting engineer to the Epsom Urban District Council waterworks, Mr. W. Vaux Graham, M. Inst. C.E., Westminster, we are able to publish a summary of the official trials which were carried out on September 14th, 1926, with the pumps delivering through two mains in accordance with specified conditions :—

Duration of test	10 hours
Engine speed	216 r.p.m.
Average depth of water in well	44ft. 9in.
Average lift above surface	308ft. 3in.
Average total lift, including friction	353ft.
Average quantity pumped per hour	124,070 gallons
Average quantity pumped per minute	2068 gallons
Average water horse-power	221·2
Average fuel used per hour	139 lb.
Fuel used per W.H.P.	·629 lb.
Fuel used per 1000 gallons raised	1·12 lb.
Fuel used per million foot-pounds (1000 gallons raised 100ft. high)	0·317 lb.
Cost of fuel per ton	£4 7s. 6d.
Cost of fuel per 1000 gallons raised	0·524d.

Since these trials were made the plant has continued to run about nine hours per day, which period will be increased to about twelve hours per day during the summer months. The pumping plant we have described delivers water from the wells at the East-

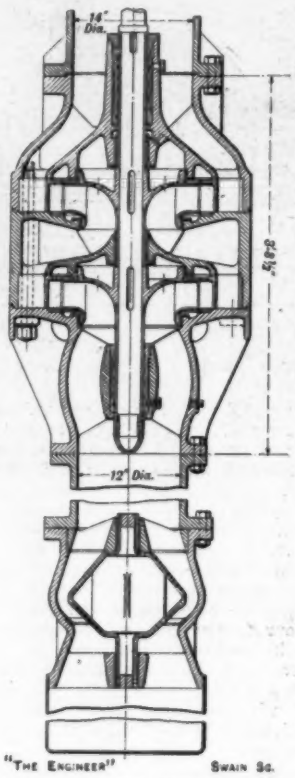


FIG. 7—WELL PUMP AND SUCTION BOX

street works to the old reservoir on the Downs-road, Epsom. Alongside this reservoir, two other north and south reservoirs are now under construction, which are designed to hold 1,000,000 gallons of water each. The contractors for this work are Holloway Brothers (London), Ltd., and the reinforced concrete construction is being carried out to the designs of the consulting engineer and Mouchel and Partners, Ltd., of Victoria-street. When completed, as it is hoped they will be during the summer, the new reservoirs will increase the total storage capacity to 2,900,000 gallons of water.

In conclusion, we would express our thanks to the consulting engineer, the contractors, and especially to Mr. Thos. N. Young, the engineer and manager of the Epsom waterworks, for the facilities afforded us to inspect and examine the plant under running conditions.

The Paris Fair.

The utility of Fairs depends upon their character, which is determined by the importance of local industries and by the class of people who visit the Fairs. At Lyons prominence is given to silks, metallurgical products and engineering. At Bordeaux maritime and colonial interests are more largely represented. In Paris the Fair is of a more universal character, because the local industries are exceptionally varied and comprise practically every class of manufacture. In a general way, the greater the range of industries covered by a Fair, the less are its chances of complete success, for the reason mainly that the limited space available does not allow of all the industries being adequately represented, and there is consequently a tendency towards the elimination of those industries which do not derive sufficient profit from their participation. The Fair, therefore, inevitably loses its universal character. In the case of Paris, the Fair has undergone many developments, and will doubtless continue to change according to the needs of the buying public. It may therefore be interesting to see in what way it may serve to bring engineering products to the notice of French buyers.

The Parc des Expositions, where the Fair is held, is one of the largest of its kind, and is situated at the Porte de Versailles. It has one big machinery hall and other buildings devoted mainly to industries outside engineering. In the grounds there are streets of small wooden shops of a uniform type, each row being given up to a particular class of product. There are sheds for wood-working machinery, motor lorries and internal combustion engines. A part of the ground is occupied by agricultural machinery, this section, however, now having only a shadow of its former importance, and elsewhere a good deal of space is devoted to road-making machinery, concrete-mixing plant, elevating machinery and the like, while economical building construction is a prominent feature. The Fair therefore offers considerable general interest, and the attendance of visitors was large, but it is not particularly instructive to those who are looking for evidences of industrial progress.

The promoters of Fairs rarely lay stress upon the technical interest of the gatherings. They are commercial organisations which aim at offering facilities for bringing together buyers and sellers. So far as engineering productions are concerned, the limitations of space do not allow of the industry being well represented, although manufacturers made the most of the opportunities given them of reaching possible customers. Apart from the Fairs, there are no shows at which makers can exhibit machine tools and other machines, and it is probable that a useful purpose would be served if the entire hall could be devoted to engineering products with sufficiently large stands for the installation of heavier classes of machinery, while accessories of all kinds that encumber the machinery section could be grouped separately.

The Fair this year showed a distinct advance on the last, in the sense that a larger foreign participation gave to it a greater variety, and allowed of a comparison which showed that, despite the advance being made by French manufacturers, there is an undoubted opening for the sale of foreign machines. French firms have been making continued and even rapid progress, and the number of turret lathes shown by H. Ernault, Caseneuve and other makers indicated how they have been developing this branch of the machine tool industry. The Etablissements Cuttat et Cie., exhibited their light automatic lathes, which are the only machines of this class manufactured in France. The universal milling machines of the Etablissements P. Huré have a high reputation, and S.O.M.U.A., which manufactures all classes of heavy machine tools, exhibited lathes, slotting and planing machines. Big vertical lathes and boring machines were shown by Sculfort, Fockeday, Vauthier et Cie., of Maubeuge. In a general way, French makers can supply practically all that is required in the average engineering shop, but, while they have improved their designs and manufacturing methods of late years, they are certainly out-distanced by the foreign industry in the manufacture of high-duty machines.

The agents of American machine tool firms never fail to make prominent exhibits wherever possible, and so long as the motor car industry was prosperous, the sales were good, despite the high prices that had to be paid. There did not appear to be any British metal-turning machines at the Fair, but Alfred H. Schutte, of Cologne-Deutz, demonstrated the economy of modern high-speed machines by showing at work a powerful broaching machine and lathes; while the Max Maag Cie., of Zurich, impressed visitors with the operation of heavy milling, gear-hobbing and gear-grinding machines. Some big German surface grinding machines were also shown. The object of the German and Swiss makers was to introduce special machines of types that are not manufactured in France. That is fully justified by the fact that the engineering industry is undergoing a process of transformation when, under stress of increasing production costs, French makers find it necessary to organise their manufacture with machines of the highest efficiency and with the least possible labour. Few makers are probably able to do this immediately, but there will certainly be in time an increasing demand for such machines. While there were no stands of British metal-working machines, the industry was represented by the Federation of British Industries, which supplied all information that might be required by visitors.

Wood-working machinery covered an extensive space in the grounds, where some big installations were shown by Panhard and Levassor, Guilliet Fils et Cie., and others. So far as wood-sawing, planing and ordinary wood-working machines are concerned, the French production is large and varied, and in view of the obvious superiority of the moulding machinery of Thomas Robinson and Son, Ltd., of Rochdale, it was to be regretted that British firms were not represented in other classes of machinery. Ruston-Hornsby oil engines were shown, as well as a Ruston oil caterpillar shovel. In the machinery hall there were a few exhibits of printing machinery, some of German make, weaving and other machinery, but there was no attempt to make any representative display of particular branches of the machinery industry, nor was it possible to do so in the limited space available. In the same way, the electrical engineering section has lost some of its comprehensive character, and is now chiefly confined to exhibits of domestic apparatus and light industrial applications, such as the driving of machines and pumps. This branch of the industry has rapidly extended and will

develop much more considerably in the future if the national electrification scheme should be carried out. There is some complaint of the difficulty of standardising motors when the current is delivered to consumers under such a variety of potentials. Wireless apparatus also occupied a large space in the machinery hall.

In the building devoted to ironfoundry productions there was little of technical interest, the exhibits consisting almost entirely of heating and domestic apparatus, and the chief interest lay in the many devices that were shown for economising gas. Motor lorries were exhibited in large numbers, several of them with suction gas equipments, and it is obvious that in these and other sections the Paris Fair offers opportunities for bringing anything new to the notice of users. In view of the success of the Fair, and the huge attendance, foreign manufacturers seem more disposed to take advantage of this means of introducing their productions to a large section of the French public.

A New Power Station at Carlisle.

YESTERDAY the new Willow Holme power station was officially opened at Carlisle, where electricity was first made available for public use on May 11th, 1899. Since that date the demand for current within the area supplied has increased considerably, and from time to time various alterations and extensions have been made to the original James-street station. Some time ago, however, it became apparent that partly on account of the rapidly growing load and partly because of the restricted area and shortage of condensing water at James-street, a new station would have to be erected in a more suitable spot.

The need for this new station was accentuated by the fact that in 1919, the Board of Trade advised the Carlisle Corporation that, owing to its isolation in an electrical sense, from any other supply undertaking, it might find it expedient to increase the area of supply. The chief electrical engineer, Mr. C. W. Salt, was therefore instructed by the Electricity Committee to report upon the situation, and in due course he prepared a scheme. In view of its magnitude and the outlay involved, the plans and estimates were referred to Mr. Arthur Ellis, consulting engineer, who recommended that the scheme should be proceeded with.

During the consideration of these matters, however, the increasing demand for electricity made it necessary to install a portion of the new plant in the James-street station, and this plant was designed for operation under the conditions that would exist at the new station. An additional turbine of 3000 kilowatts capacity was installed by the British Thomson-Houston Company, and the necessary boiler plant by the Stirling Boiler Company. Whilst this temporary installation eased the situation considerably, the City Council, in view of the anticipated increase in the demand for electricity and also on account of Unemployment Grants Committee's willingness to make a grant in aid of the scheme, decided in October, 1923, to accept the Electricity Committee's recommendation to proceed with the completion of the scheme on the new site.

FIG. 1—LOW-TENSION SWITCHBOARD

The site selected for the new power station at Willow Holme on the bank of the river Eden, meets all the requirements of a modern electricity scheme. At all times there is an ample supply of water for condensing the steam of a plant of at least 100,000 kilowatts capacity. The area of land possessed by the Corporation is sufficient for practically unlimited extensions, and there are railway facilities for handling coal, &c. The existing turbine house is 201ft. long by 44ft. wide, whilst the boiler-house, which is parallel to it, is 181ft. long by 72ft. 6in. wide. Between the boiler and turbine houses there is an annexe 15ft. 6in. wide, in which the main steam headers, steam receivers, booster pumps, boiler feed pumps, &c., are accommodated, and de-aerators, evaporators and feed tanks are placed above the basement floor level. The switchgear annexe is 17ft. wide, and it provides accommodation for a block of offices, a repair shop, equipped with machine tools, and a battery for operating the switches.

FIG. 2—HIGH AND LOW-TENSION SWITCHBOARDS

At present the boiler-house—see Fig. 6 on page 578—contains four Stirling boilers, equipped with integral superheaters and Underfeed self-contained stokers, together with a Green's economiser and Davidson induced draught fan—see Fig. 4. With the moderate-sized units which were to be used in the turbine-room, it was found possible to install boiler plant of sufficient capacity on one side of a boiler-house of equal length to the turbine-room, leaving the other side available for windows. The steam-raising capacity of each of the boilers is 30,000 lb. per hour, whilst a boiler to be transferred from the James-street station has a capacity of 25,000 lb. per hour. The steam pressure is 255 lb. per square inch, and the total steam temperature 650 deg. Fah. At its entrance to the economisers, the feed-water temperature is 140 deg. Fah. All the boilers are capable of 20 per cent. overload, and all fans, stokers, conveyors, &c., are naturally proportioned accordingly. Each boiler has a heating surface of 8303 square feet, whilst the superheaters have a surface of 992 square feet. The economisers consist of 240 10ft. pipes. A chimney, 70ft. high and 6ft. 6in. in diameter, is shared by two boiler units. A covered annexe accommodates the coal-receiving and handling plant, and also the rail siding which terminates in the turbine-room, thus permitting heavy plant to be placed directly under the turbine house crane. For working this siding a fireless steam storage locomotive is provided. A hopper below railway lines receives the coal from the railway wagons, and from this hopper the coal is fed into a gravity bucket conveyer for distribution to the storage bunkers situated in front of the various boilers. A water-submerged conveyor removes the ashes continuously, and delivers them into an elevated ash hopper outside the boiler-house. Ashes and soot can also be removed by trucks running on rails in the boiler basement. In accordance with modern practice, the boilers are well equipped with instruments, including Kent steam flow meters, temperature indicators for the superheated steam, feed-water and flue gases, dial draught gauges and electrical CO_2 recorders, supplied by the Cambridge Instrument Company, Ltd. An automatic weighing machine is also provided for checking the coal consumption of each boiler, and there are meters for measuring the amount of feed water, make-up water being checked by meter at the evaporator feed inlets. Diamond soot blowers, supplied by Babcock and Wilcox, are fitted to all the boilers.

The turbine house is designed to accommodate two 6000-kilowatt, one 3000-kilowatt, and one 2000-kilowatt turbo-generator sets, but at present only contains the 6000-kilowatt set—Fig. 5, page 578—which was supplied by the British Thomson-Houston Company. The 3000-kilowatt and 2000-kilowatt units are to be transferred from the James-street station as soon as possible, whilst the additional 6000-kilowatt set will be installed as soon as the load demands it.

From what has been said concerning the boiler plant, it will have been gathered that the steam conditions of this new station are not by any means exceptional, the object aimed at, we are told, being to obtain the highest thermal efficiency compatible with reasonable capital and maintenance costs. Steam is admitted to the new 6000-kilowatt set at a pressure of 250 lb. per square inch, and superheated to a total temperature of 650 deg. Fah., and it exhausts into a vacuum of 29·1in. Branches are arranged on the turbine, so that steam can be bled for feed-heating purposes. The speed of the machine is 3000 revolutions per minute, and it is designed to develop 7500 kVA—6000 kilowatts at 0·8 power factor—at 3300 volts, and 50 cycles per second, the overload capacity being 25 per cent. for two hours. The turbine is a Curtis ten-stage machine, the first stage having two rows and each of the remaining stages a single row of blades.

The condensers are installed at right angles to the centre lines of the turbines with the water inlets nearest to the river side, as that permitted of a convenient arrangement of the steam and water pipe lines, which approach the sets from opposite directions. The surface condenser of the new 6000-kilowatt unit, which is shown in Fig. 7 on page 578, is designed for a duty of 65,000 lb. of steam per hour, and to maintain a vacuum of 29·1in. when supplied with 9500 gallons of circulating water per minute at a temperature of 55 deg. Fah. The condensing plant is provided with duplicate air and extraction pumps, and the motors driving the extraction pumps, together with the control gear, were supplied by the B.T.H. Company. The condensing plant, the feed-water evaporators, the de-aerators, surge and crude feed-water tanks, together with the interconnecting piping and valves, were supplied to the specifications of the city electrical engineer by the Mirrlees Watson

Company, Ltd., of Glasgow. There are two condensate pumps, each driven by a 13 horse-power squirrel-cage motor, running at a speed of 1440 revolutions per minute. Each pump is capable of dealing with the full quantity of condensate, and a control system is provided to ensure a steady flow of the condensate and to prevent the pumps de-priming. There are two Mirrlees steam ejector air pumps with an intermediate surface condenser between the two stages of the pumps. Each pump has a capacity of 35·5 lb. of air per hour, and the discharge from the second stage of the ejectors passes to the small surface heater, so that practically the whole of the heat from the operating steam is recovered in the condensate or feed water.

The make-up feed water is evaporated by means of two Mirrlees distillers, furnished with a common separator chamber. The capacity of each is 6500 lb. per hour. The steam used for operating these distillers is that exhausted from the turbine feed pumps, but when necessary this supply is augmented by boiler steam, introduced through a reducing valve. Together with the condensate the distilled water is circulated through the de-aerating system. There are two de-aerating plants, both built on the "flush" principle, the water to be treated being heated up to a temperature of about 20 deg. Fah. above the de-aerating chamber temperature. The de-aerating plant comprises four vessels:—(*a*) The ejector heater for condensing the steam used by the ejector for maintaining the necessary vacuum in the de-aerating vessel; (*b*) the vapour condenser in which the steam formed by flashing in the de-aerating vessel is condensed; (*c*) the direct contact heater which raises the condensate of feed water to the temperature necessary for de-aeration; and (*c*) the de-aerating vessel itself, in which the water gives up the air or incondensable gases. From this vessel the water is extracted by a condensate pump, which delivers the water direct to the turbine feed pumps, the vapour from these distillers being used in the direct contact heater or, alternatively, if the distillers are not in use, the exhaust steam from the boiler feed pumps can be used for that purpose. In order that the temperature of all the units can be read and easily compared at one spot, electrical distance thermometers are fitted to all the heaters.

On its way from the condensate pump to the de-aerator, the condensate passes through the ejector air pump condenser, ejector after-heater, and bled steam heater, into a common ring main. On the existing 2000 and 3000-kilowatt sets that are to be re-erected in the new station, bled steam heaters will also be fitted and the condensate from the respective sets will be passed through these heaters before going into the condensate ring main, which is to be connected directly to the two surge tanks and the de-aerating plants. The clean drain water from the distillers also passes into the surge tank, so that the whole of the feed water passes through the de-aerating plants before going to the boilers.

On the river bank there is a separate pump house, which will ultimately contain four electrically-driven circulating water pumps and two service pumps. At present there are two circulating pumps, each having a capacity of 588,000 gallons of water per hour, with their centre lines 2ft. below the river bed, so as to ensure an immediate flow on starting, and each pump is driven by a 120 horse-power vertical motor placed above the maximum recorded flood level of the river. Two vertical-spindle service pumps, each having a capacity of 27,000 gallons of water per hour against a head of 66ft., provide a supply of water for screen washing, the evaporators and for cooling bearings. There are two travelling band screens, with a total effective screening height of 32ft., and at the minimum immersion of 11ft. Each screen will pass 1,200,000 gallons per hour.

All the switchgear was designed and manufactured by the British Thomson-Houston Company, Ltd., to the specification of Mr. C. W. Salt, the city electrical engineer. The high-tension equipment is enclosed in artificial stone cubicles—shown in Fig. 3. Duplicate three-phase bus-bars are supported on heavy porcelain insulators, which are clamped to the stonework by metal flanges, so that they can readily be replaced. The feeder and machine equipments are isolated from the bus-bars by lever switches mechanically-operated through insulated levers outside the cubicles. The oil circuit breakers are operated by means of solenoids controlled from panels on the gallery overlooking the turbine house, this gallery—which is shown in Fig. 2—forming the upper floor of the switchgear annexe above the high-tension switch chamber. For making or breaking a circuit the isolators cannot be used. Any attempt to make an isolator serve for that purpose would result in the circuit breaker being tripped, and it could only be closed after the isolator had been closed. The current and potential transformers are in separate isolated cubicles. The main machine equipments are in the centre of the switchgear bank. All the exciters are controlled from pedestals placed in front of the generator control panels—as shown in Fig. 2—and the exciter and main rheostats are situated at the rear of the gallery. Three trunk feeders run to the James-street station, where, as already indicated, the generating plant is to be shut down and the station is to be used as a distributing sub-station. These feeders are provided with the B.T.H. system of balanced current protection, and provision is made for modifying it should it be necessary to take a supply from the James-st. station. Uniformity of high-tension voltage is maintained by B.T.H. Tirrill regulators. The low-tension switchboard shown in Fig. 1 is erected in line with the main high-tension control board on the gallery, and it is of the usual "back of panel" type, with the various equipments separated by steel barriers.

The 45-ton travelling crane in the turbine room was supplied by A. Jack and Co., Ltd., of Motherwell, and the large water valves by Blakeborough and Sons, of Brighouse. The feed pumps in the turbine house annexe were made by G. and J. Weir, Ltd., of Glasgow; the high-pressure steam valves by Durance and Co., London; and the steam drain valves by Hopkinson, Ltd., of Huddersfield. In addition to the draught fans in the boiler-house, Davidson and Co., of Belfast, supplied the grit arresters; and W. and T. Avery, Ltd., of Birmingham, the weighing machines and the weighbridge. The battery in the switchgear annexe was supplied by the Tudor Company, Ltd., of London; and the transformers by the Brush Electrical Engineering Company. The fireless locomotive was built by A. Barclay, Sons and Co., Ltd., of Kilmarnock; Worthington-Simpson, Ltd., of London, supplied the circulating water pumps; F. W. Brackett and Co., Ltd., of Colchester, the circulating water screens; Pratchitt Brothers, of Carlisle, the condenser water piping; and H. Morris, Ltd., of Loughborough, the 3-ton travelling crane in the pump house. The interconnecting cables between the old and new stations were made by British Insulated Cables, Ltd., of Prescot. Mr. C. W. Salt, the city electrical engineer, was responsible for the general design of the new power station and transmission system.

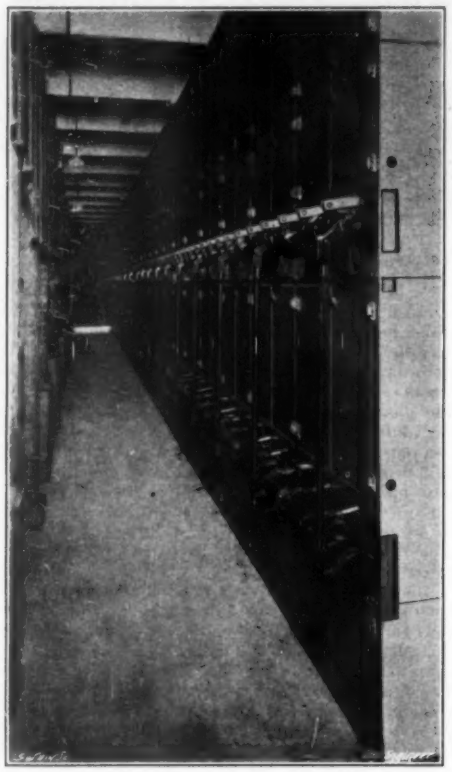


FIG. 3—H.T. SWITCH CUBICLES

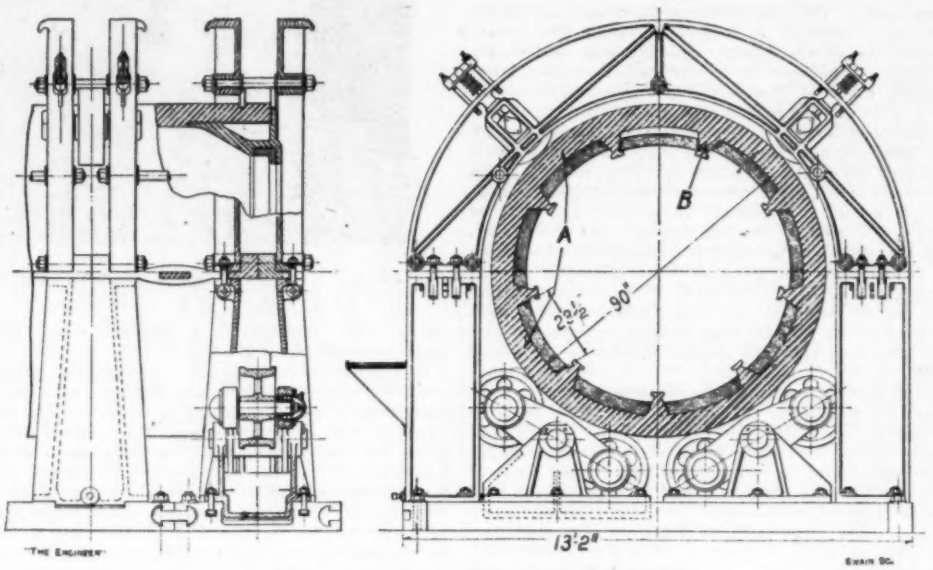


FIG. 1—CENTRIFUGAL BAR-CASTING MACHINE

The Centrifugal Casting of Bars.*

By LEON CAMMEN.

CENTRIFUGAL bar casting is for all practical purposes a new art. While several attempts have been made to cast bars, gears, &c., in the past, none of them led to satisfactory results, and practically all such attempts were usually abandoned after a few trials and without comprehension of the reasons which made the attempt abortive.

Referring to Fig. 1 and considering only the barrel part of the mould A, one will see what amounts to a mould for casting tubular shapes. It differs from such a mould, however, because of the presence of partition lugs B. Assume now that we employ this mould in the same manner as we would employ a mould for making tubular castings, as has been actually done by a number of would-be inventors of centrifugal bar casting. Offhand one would suppose that the problem is very simple. Centrifugal force throws the metal to the wall and if the metal be delivered to such mould as shown here it ought to be thrown to the bottom of the cavities between the partition lugs and form little ingots therein. It actually does it in as far as the forming of the ingots is concerned. The only trouble is that the metal thus formed is absolutely worthless. A clear understanding of the reasons for this failure will give an inkling as to the metallurgical mechanism of centrifugal bar casting.

The mould shown in Fig. 1 is spinning on a horizontal axis. The partition lugs may be anything from 5in. to 15in. long, the inside diameter of the mould from 50in. to 100in. and the speed of the order of 6000ft. per minute on the inner surface. When molten metal is coming down from the spout into a mould of this size and running at such a speed it is apt to be hit by the partition lugs and broken up into a fine spray. This spray instantly chills in the air and comes down into the metal in the form of shot. Some of this shot is re-melted and re-incorporated into the metal, some of it is not. The result is that when the bar is rolled the cold shot is knocked out and holes are left in the rolled product. Some years ago at the works of a certain electrical company, bars were made by this process. After casting they looked fine, but when rolled out into sheet the product had more the appearance of a screen than of sheet.

This difficulty has been overcome in the Cammen process by the construction shown in Fig. 2. The metal is teemed against the smooth-walled, restricted neck E of the mould; here the metal is picked up by the rapidly spinning mould and pressed by centrifugal force against the wall of the mould. It cannot get out of the mould because of the presence of the collar G, and therefore has to go the other way. It is thus forced down over the shoulder H, gaining in centrifugal force as this is done, because of the increase in diameter. By the time it reaches the beginning of the partitions at J it is already spinning at the same rate as the partitions themselves. There is therefore no relative motion between the two and no blow, the metal generally flowing around the shoulders of the partition lugs and filling the spaces in between. This is what is actually happening in the machines and resulting in the production of bars absolutely free from cold shots. The use of this device at the end of the mould, called "bottle neck," is one of the characteristics of this process. Equivalent designs have been developed and covered by patents. The only one, however, which is believed to have a real production value is the one shown in Fig. 2.

MECHANICS OF CENTRIFUGAL BAR CASTING.

Let us see now what happens when bars are cast and why this process is believed to have a metallurgical and technical value. In contradistinction to centrifugal tube casting, centrifugal bar casting permits the handling of large amounts of metal from perhaps 5 or 6 tons for sheet, bar and wire rod moulds up to some 30 tons per machine in rail and structural steel billet casting. Because of this a close control can be had on the rate at which molten metal is delivered to the spinning mould. As the first metal comes in it instantly freezes, probably close to the beginning of the partition lugs. The next metal, however, flows a little way over the hot metal previously solidified,

* From a paper entitled "Centrifugal Casting of Steel," presented before the American Society for Steel Treating at Washington, January 20th and 21st, 1927. The first portion of the paper dealt with the centrifugal casting of tubes, and is here omitted.

rather than over the cold wall, which gives it a chance to reach further out into the mould and really produces an equivalent of tube casting in a hot mould. In this way from the first metal teemed from the ladle a thin layer is formed the full length of the mould, which may be anywhere from 6½ft. to 14ft. and more long. As the next metal comes in, it is flowing over the layer of extremely hot metal which has just solidified. It is important to teem the metal from the ladle into the machine at such a rate that at no time should there be a layer of molten metal present of a thickness greater than, say, ½in. Fig. 3 shows diagrammatically an original solidified layer of metal in immediate contact with the mould, and the next layer thereon which is still molten. As will be made clearer later, the rate of teeming is one of the most vital influences affecting the structure of the cast bars.

Now a continuous process takes place. As more molten metal is added at the top of the layer of molten metal already present, the bottom of this layer solidifies and in this way the thickness of the solid layer is increased while that of the molten layer stays approximately without change. This has several results. In the first place, the paratively thin layer of the ultimate metal structure is at best affected by the presence of gases, even should the metal freeze in such a manner as to prevent their possibility of escape. In that layer, however, the gas liberating from the metal may be unable to escape and small blow-holes may be formed. The question of speed at which the machine is run becomes of importance here.

The centrifugal force exerted on the metal during spinning varies as the square of the number of revolutions, let us say per minute, so that if the "factor" at 200 revolutions is 4, the factor at 300 revolutions becomes 9, &c. The higher the speed the greater will be the pressure of the metal outwards, and the greater will be the tendency to force out all gases as they form towards the innermost layer and thus possibly out of the metal entirely. As a matter of fact, some interesting tests were made in a demonstration machine of small diameter and hence running at comparatively high speeds. Bars were cast some 6½ft. long, 4in. wide, and about 1¼in. thick, the purpose of such a test being to determine the most difficult conditions under which the process can be applied, the combination of considerable length of bars with their small

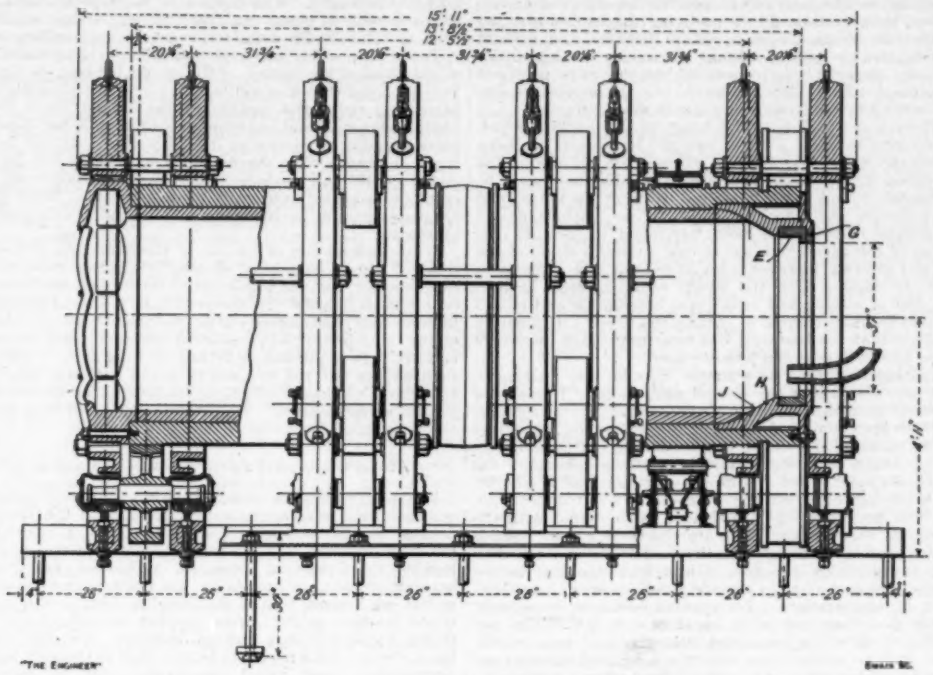


FIG. 2—CENTRIFUGAL BAR-CASTING MACHINE

solidification of the metal proceeds at a fast rate so that roughly not more than 30 to 45 seconds, and possibly much less, elapses between the time the metal leaves the ladle and the time it solidifies in the mould. Compare this with, say, 15 minutes to half an hour that the same process takes inside of a 3-ton ingot under the usual practice. It is this very great rapidity with which the metal freezes that makes it practically impossible for segregation to take place.

In an ordinary ingot, freezing proceeds in the following way. The shell of the ingot rapidly freezes all around while the central core remains molten for a long time. As the metal freezes it contracts and as the freezing proceeds from the outside of the shell inward, a contraction takes place in the shell while the central part of the ingot is still liquid. When the ingot finally freezes a series of planes of weakness are formed which in a rectangular ingot are directed roughly along the diagonals of the horizontal section. The larger the ingot the greater and more dangerous are these planes of weakness. Without going into detailed discussion of their origin, which is well known, it may be said that the most essential condition for the formation of such planes of weakness in an ingot is availability of time. In centrifugal casting no such time is available, and hence the most important condition is removed, so that "ingotism" becomes impossible. Furthermore, the freezing proceeds in thin layers and the metal while freezing is perfectly free to draw from the molten layer present at its top until the final layer is being formed. Because of all this, centrifugally cast bars have been found to be absolutely free from such planes of weakness as are encountered in stationary ingots.

Elimination of Gases Contained in Molten Metal.

When we come to the matter of gases, a somewhat more complicated condition is found to exist. All molten steel contains a certain amount of gases held in solution. As the metal chills its ability to hold the gases decreases and a liberation of gases takes place. This action is extremely rapid and will take place even during the short period of freezing available in centrifugal bar casting. As the temperature of the bottom of the molten layer decreases from that at which it reached the bar initially to that of freezing, the metal liberates gases which gradually accumulate in the molten layer maintained on top of the bar by flow from the ladle. The ability of this layer to hold the gas in solution is, of course, quite limited, so that after a while a discharge of the gases from the metal into the air takes place and the topmost layer may be considered in the light of a saturated solution of gases in question in the metal. As long as new metal is supplied to the bar this condition will be maintained more or less stationary. It is only when we come to the topmost layer at the end of the casting that we have to consider what happens to the gas dissolved in the metal. The answer depends on the rate of freezing of the topmost layer and on the velocity of rotation of the machine. If this topmost layer is thin, metal being supplied from the ladle at a comparatively slow rate only a comcross section being, of course, such as to make the application of the process most difficult.

When the machine was run at 900 revolutions, which gave a factor of 8·1, and low carbon (0·09 to 0·12 per cent.), effervescent steel was teemed, the outside layer of the bars was found to be quite good, but the inside layer to a depth of about ½in. was full of blow-holes, some of them more than ½in. in diameter. The speed was then raised to 1100 revolutions, giving a factor of 12·1 or about 50 per cent. higher than before. The change in the character of the section of the bar was extremely interesting. In many places the porosity disappeared completely, the bar being solid throughout. In other places some porosity still remained, but it extended to only about ½in. from the innermost face of the metal and the blow-holes were now small. The frame of the machine was not strong enough to permit operating it at 1200 revolutions, which would give a factor of 14·4, particularly as sufficient infor-

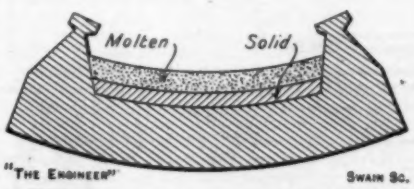


FIG. 3—FREEZING OF A CENTRIFUGALLY-CAST BAR

mation was believed to have been obtained from the runs at 900 and 1100 revolutions per minute.

Structure of Centrifugally Cast Bars.

In speaking before a body of experts, it is unnecessary to explain formation of pipe in an ingot. The recognised theory to-day is that it is due in part to evolution of gas on freezing, essentially in the manner described above, and in part to the fact that in an ordinary ingot the external surface solidifies first, and the core last. The volume of the ingot is, therefore, determined on the solidification of the shell, and when the core solidifies and contracts it can only do so at the cost of forming a cavity. This can be prevented in part by such methods as hydraulic compression of ingots, which, however, are not applicable to the great majority of steel products. Another method widely resorted to is the use of dozzles or hot tops, but this means only transfers the pipe cavity from one part of an ingot to another. In centrifugal cast bars the same process takes place. As the bottom layer solidifies it contracts and if left alone would form contraction cavities. There is, however, an overlying layer of molten metal powerfully pressed against the solidifying lower layer, and this serves efficiently to fill up contraction cavities. It is only the last layer of metal that has no such source of molten steel to help it out, but here contraction is limited to only a thin strip, probably not more than ½in., and such contraction cavities as may occur are apparently too small to be noticed. On the other hand, if metal is teemed into the mould too fast, and particularly if too much vibration is present in the mould, the surface is apt to be rough or wavy.

Because of this, in a properly teemed bar, there will be no cavity. Emphasis should be laid, however, on the bar being properly teemed. If the metal is supplied to the mould at an excessively fast rate, a heavy layer of molten metal is present at the end of the teeming. It may—and actually has—happened that the outermost face (i.e., the one toward the inside of the mould) exposed to the cooling action of the air will freeze first, and the inner layer of molten metal next. In such a case contraction cavities will be formed substantially in the same manner as in a stationary ingot. However, instead of lying inside the ingot, they will all be at some distance below the inner surface of the bar. This does not make them any more desirable, and the greatest attention should be paid to determining for each size of bar cast, each size of machine, and each speed of machine used, the proper rate of teeming which can be then maintained by using a nozzle of the proper size.

Mechanical and Operating Details.

Because of the novelty of the process of centrifugal bar casting something might be said about the details of its application. The purpose of centrifugal casting is to provide material for use in rolling or forging. Let us consider the former. To-day for rolling such as, for example, rails, a large ingot is cast, say, 24in. by 24in. in cross section, some 6ft. long. The ingot is then delivered to the soaking pit and thence to the blooming mill, where it is converted into a billet or slab suitable for the production mills (this term will be used henceforth to cover the roughing and finishing mills). The purpose of centrifugal bar casting, on the other hand, is to produce a bar of such a size and character of metal that it would be directly suitable for rolling in the production mills and would give an ultimate product of a quality not inferior to that produced by the ordinary process. This means that the character of the material should be such that the ultimate result would not be affected by the elimination of blooming. The section of the bar should be such as to be directly suitable for use in the production mills and its length should be such as to make the use of production mills economical.

Several considerations are involved here. The first of them is: Why is blooming required to-day? Tests made some years ago at the Bethlehem Steel Company on forgings have shown that even if the cross section of an ingot is reduced by forging in the ratio of 64 to 1, which is more than any blooming ever did, ingotism is by no means completely eliminated. On the other hand, blooming in present ingot practice is used for excellent reasons. The ingot as cast to-day has an extremely variable structure, the metal being fine-grained and strong in the shell which freezes first and does it rapidly. It is coarse, pipy and vitiated by planes of weakness in other parts of the ingot, especially the core, where freezing is slow and where it proceeds simultaneously with the development of considerable mechanical strains. What blooming does is, by rolling the metal at practically welding temperatures and under enormous pressures, to equalise the structure more or less throughout the body of the metal and to eliminate to a greater or lesser extent the weak spots enumerated above. Where, as in centrifugally cast bars properly made, these weak spots do not exist and where the structure of the metal is fairly uniform to start with, blooming would not improve the metal, and it can be safely eliminated. As a matter of fact, sheet was rolled from bars not more than 1¼in. thick and the physical characteristics of the product were in no way inferior to those of sheet rolled from conventional big ingots.

Figs. 1 and 2 show two sizes of machines, one comparatively small for casting sheet bars 53½in. inside diameter of mould and 12ft. long, and the other for casting plate bars 90in. in diameter and 14ft. long. A machine is now being designed for a licensee to cast rail bars 9in. by 10½in. by 13½ft. to take 28 tons of metal per operation; the other two machines taking respectively 6 tons and 17 tons. Not enough practical experience is available to-day to tell exactly how many machines of each size would be needed to take care of a furnace of, say, 120 tons. It is expected, however, that five machines with one standby of the smallest size here shown would be amply sufficient and three machines with one standby of each of the larger sizes.

Rate of Teeming in Bar Casting.

As indicated above, the matter of rate of teeming of metal from the ladle is of the most vital importance for the success of the process. During teeming a layer of molten metal of not more than ½in. should be maintained in the machine, and it may be added that if such a layer could be maintained in an ordinary ingot, the metal produced would be probably as good as when made by centrifugal casting. Centrifugal force, while rendering certain useful services, is not an absolutely essential element to the success of the process apart from help in distributing the metal, and it is the rate of cooling of the bar that contributes the vital share to freeing it from the defects of the conventional ingot. Take an ingot 24in. by 24in. by 72in. long. Assume that it takes twenty seconds for a layer ½in. thick to freeze. It would need, then, over 1½ hours to teem such an ingot, which is obviously out of the question. Take, on the other hand, the 90in. machine shown in Fig. 2. This contains eight bars, which will be described as being, for the sake of simplicity of calculation, 24in. wide and 14ft. long. In such bars a layer of metal ½in. thick represents 2688 lb., so that assuming the freezing at the same rate as above, we get a rate of teeming close to 3½ tons per minute, which is not only perfectly possible, but in fact much faster than is done in teeming conventional ingots to-day. In other words, by laying ingots on a side instead of filling the mould vertically and by providing in each machine a considerable number of bars cast at the same time, we succeed in combining a fast rate of teeming from the ladle, which is of advantage from the shop point of view, with a slow rate of building up the ingot (eliminating segregation and ingotism), which latter also means a fast rate of freezing of the metal, an ideal

combination totally impossible when casting large ingots in a stationary mould. The same in a small way is being done in casting small ingots, such as tool steel, by the so-called tundish process, but is not suitable to big ingot casting for several well-known reasons.

The metal is delivered to the mould through a spout—Fig. 2—from a conventional ladle equipped with such a nozzle as the new use may call for. The ladle crew is not affected. There is a man on the floor acting as a foreman, who watches the metal come into the machine and notifies the ladle crew when to shift to the next machine or stop pouring. By standing in front of the machine and looking into it one can see the metal come in and the bars being built up. Because of the provision of the bottle neck at the pouring end and the powerful pressure exerted on the metal by centrifugal force, there are no sparks of metal flying out at the other end and it is perfectly safe to stand in front of the machine at some distance. At the left end of Fig. 2 is observed the "gauging head," which is a spillway for the metal. This determines the thickness of the

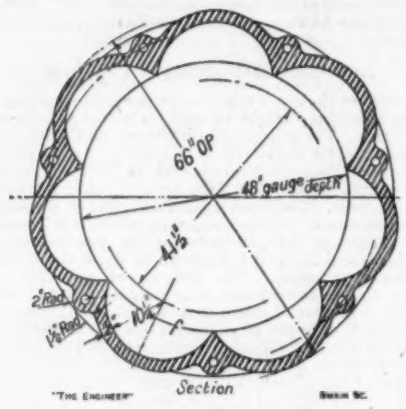


FIG. 4—GAUGING HEAD

bar cast. As the metal comes in it gradually builds up in thickness and when it nearly reaches the height of the gauging head the foreman on the floor signals to the ladle crew. It is always of advantage to pour a little over. As the last metal coming from the bottom of the ladle is apt to carry a lot of dirt, it is of advantage to permit in the last pouring quite a little of the metal to run over the spillway. This will secure the elimination of the dirt from the last teem. This spillway or gauging head is shown in Fig. 4. Metal which overflows into the head forms in the lobes little castings, which are easily shaken out of the head when it is removed for withdrawing the bars and do not stick therein as would a solid ring.

Handling the Cast Bars.

We have now reached the stage where bars of proper shape and thickness have been formed in the machine. The next problem is how to take them out. Fig. 5 shows various devices for withdrawing the bars from the mould. As will be noticed in the left part showing a cross section

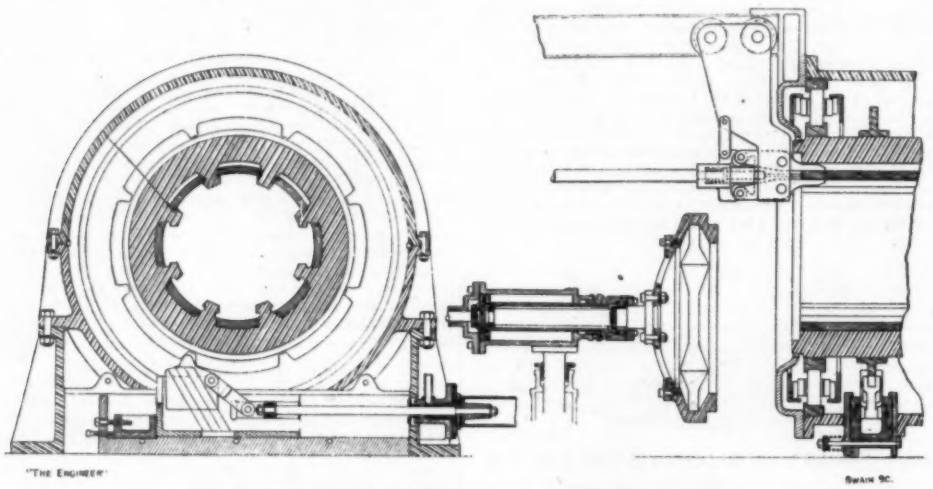


FIG. 5—DEVICES FOR WITHDRAWING CAST BARS FROM MOULD

of a mould with the castings, the partition lugs are provided with shoulders. This is an important feature of the mould. Had there been no shoulders on the partition lugs or some similar device, the bars would fall in a heap when the machine slows down at the completion of the teeming; this not only might lead to denting of the surface of the mould by the bars indiscriminately thrown about, but would make their extraction from the mould a difficult and uncertain job. To avoid this, the lugs are so designed as to permit the top bar or bars to clear away a certain distance from the wall of the mould and yet not far enough to fall out completely.

When the metal has been all teemed into the machine a brake is applied to the mould rapidly stopping its rotation, and a device (not shown) stops the mould in exactly the position shown in Fig. 5. As shown in the centre of that figure, the gauging head can be moved horizontally by one hydraulic cylinder and vertically by another cylinder. As soon as the machine stops the gauging head is pulled out of the way sufficiently to leave one or two of the bars on top of the mould free to come out. The pulling device diagrammatically shown in the right-hand part of Fig. 5 is next brought into operation. This consists of a grab operated by a hydraulic cylinder so arranged as to engage one, two or more of the bars. As soon as one bar has been pulled out the "mould-stepping device" shown at the bottom in the left-hand part of Fig. 5 is brought into operation, turning the mould through such an angle as to bring one or more bars in line with the grabbing device, the bars pulled out being in the meantime delivered to a car or conveyor. The pulling device and the mould-stepping device are so interconnected that one actuates the other and the general arrangement is such that one man in the gallery can operate five machines without trouble by pulling a series of interlocking levers.

While it is believed that ultimately the operation of the machines will be made so positive and reliable as to permit sending the bar from the machines directly to the production mill, it is proposed to-day to place a reheating furnace between the casting machines and the rolling mills so as to ensure to the bars a uniform and proper temperature.

Experiments would indicate that a wide selection of sizes is possible as far as the ability to make the bars is concerned. Bars 6½ft. long and 4in. wide have actually been cast in thickness of less than 1in., and, of course, the bigger the bar the easier it is to cast it. Hence, only economic considerations will govern the selection of size of bar, these considerations resolving themselves into the matter of effecting a compromise between the cost of casting and the cost of rolling. Obviously the bigger the bar, the cheaper it is to cast it, but the more passes it requires in rolling. The lighter the bar, the more expensive the casting becomes, and the cheaper the rolling.

There is one feature in the design of the machine which threatened to cause a lot of trouble, but which has been overcome in a simple manner. This is the question of the partition lugs. It is, of course, possible and may be ultimately found wise to cast the barrel of the mould and the partition lugs in a single piece. In fact, a special design of milling machine has been developed to machine the inside of the barrel and lugs so cast. Careful study of the subject showed, however, that at present any attempt to cast the lugs in with the mould would increase greatly the cost of casting and subsequent machining, and be apt to lead to more trouble in casting the barrel. It must be realised that the barrel in this case may weigh anywhere from 25 to 100 tons and possibly more.

Casting the barrel as a simple cylinder and putting in the lugs afterwards has several advantages. It makes a pattern unnecessary, makes the casting much simpler, reduces the chances of warping, and makes the machining of the inside of the barrel, where a boring mill of sufficient size is available, a comparatively simple proposition. On the other hand, when it comes to casting metal in a barrel with the lugs attached, grave possibilities of trouble begin to loom up. The lugs are slender as compared with the barrel of the mould. They are therefore apt to become heated through contact with the molten metal, more than the barrel, unless the flow of heat from the lugs to the barrel is so perfect as to provide a rapid means of equalisation of temperature. Previous experiments have indicated that there can be no rapid flow of heat where two bodies of metal are connected otherwise than molecularly, and that no matter how well two machined surfaces are fitted together the break between them offers a formidable obstruction to the flow of heat. It was therefore to be feared that the partition lugs would become heated faster than the barrel, expand, and tend to warp the barrel, which has enough troubles of its own without this additional complication.

To avoid this a design was developed in which the partition lug is deliberately machined so as to leave on both sides a liberal space between it and the barrel of the mould. The lug is attached to the barrel by means of studs and pins on both sides are provided to keep the lug in position. Metal, preferably iron, is then electrolytically deposited between the partition lug and mould on both sides, the parts on which it is not desired to deposit any metal being painted over with molten ceresine. The edges of the lugs are then spot welded to the mould. While the mechanical strength of electrolytically deposited iron is uncertain, this does not matter in the present instance, as the studs are relied upon to hold the lugs in position. On the other hand, such a deposit affords an excellent path for the flow of heat as has been amply proved by experiments. An effort was also made to form a deposit between the lug and barrel of the mould by the Schoop process. This has not led, as yet, to perfectly conclusive results, although there is reason to expect that it may be applied.

Life of Moulds.

This is an important subject, affecting, as it does, the cost of bars produced by centrifugal casting. It is regrettable, therefore, that not enough information is available to state with authority what the life of the mould would be under given conditions. The rather limited practice in the past has shown that moulds are only little affected even when working under the most strenuous conditions. The following should be taken into consideration in this connection. The moulds in bar casting machines are extremely heavy, weighing from four to seven times as much as the metal cast, and the cast bars are removed quite rapidly. Because of this the mould never becomes very hot, and, in fact, it is not desired that it should exceed, say, 500 deg. Fah. at any time.

The surface of the moulds is carefully machined and the bars, when being pulled out, rub against the shoulders of the partition lugs and not against the barrel of the mould, which is also in favour of a longer life of the mould. The mould material, which is of soft steel, and the circular shape of the mould are so selected as to present the best resistance to cracking due to thermal stresses. There are, however, two sources of trouble to be considered. One is burning out of the mould in spots, possibly at places where in casting the barrel a small blow-hole was formed under the skin. Should this happen, all that is necessary to do is to take the mould out of the machine, drill out the burnt spot to uncover sound metal, and deposit electrolytic iron into the bad spot. This method is successfully used to repair erosion in guns, and the huge size of the moulds, 50in. to 120in. inside diameter, makes its application easy.

The other possible source of trouble lies in the possibility of oxidation of the surface of the mould between castings. It is expected that this will be taken care of ultimately by depositing upon the surface of the mould some non-scaling material, and experiments made thus far show a good promise of success in this direction. It has been found, however, that the tendency to scale is not great, and a mould will probably stand at least 1000 castings before it has scaled sufficiently to make trouble. When this happens the partition lugs may be taken out and the mould re-bored.

While this feature of the life of the mould has hitherto received only a somewhat sketchy treatment, it must be remembered that the whole art of centrifugal bar casting is only in its infancy. At the same time it should be borne in mind that it has already attracted the attention of some of the most powerful independent steel companies in this country. In a process promising to save some 3 dollars to 6 dollars per ton of steel it would not take long to straighten out such details as protection of the mould against surface scaling. The above estimate of savings is, however, made for moulds not so protected.

Advantages of Centrifugal Bar Casting.

The question may be raised as to what are the advantages of centrifugal bar casting as compared with the present method of ingot casting and blooming. Not enough work has been done yet to establish with certainty that centrifugally cast material possesses properties essentially superior to steel well made by the conventional process. It has been found that if the metal is dirty in the ladle it will be dirty in the casting, so that centrifugal casting is not a cure for poor furnace operation. On the other hand, there is good reason to believe that in properly made centrifugally cast metal segregation will be entirely eliminated or at least greatly reduced. The main value of centrifugal bar casting—and herein it differs materially from centrifugal tube casting—lies, however, in the matter of costs. The reduction of cropping from an average of 12 per cent.—running as high as 20 per cent. in some special cases, such as rails—to about 2 per cent. and the elimination of the entire blooming operation with all it implies, are equivalent to a reduction in costs of from 3 dollars to as high as 6 dollars per ton on standard products.

To existing steel plants the elimination of the blooming mill will not be entirely welcome, perhaps. Few like to think of scrapping 100,000,000 dollars' worth of equipment, some of it very new, even if economies are to be secured by such an operation. New mills will, however, appreciate a cut in initial cost of the order of 2,000,000 dollars to perhaps 2,500,000 dollars.

THE NEWCOMEN SOCIETY: SUMMER MEETING.

The following particulars regarding the summer meeting of the Newcomen Society, which is to take place in the London area, on Thursday, Friday and Saturday, June 16th to 18th inclusive, have been made public:—

On the morning of Thursday, June 16th, at 10 a.m., members will assemble at the entrance to the Mint and will be conducted over the operative department of that institution, by permission of the Deputy Master, Colonel R. A. Johnson, C.B.E. In the afternoon, starting at 1.30 p.m., a visit will be made by motor coach to Bryant and May's match works and museum of fire-making appliances, Fairfield-road, Bow, by invitation of the firm. This visit is to mark the centenary of the discovery of the friction match. At the conclusion of the visit the party will drive to Epping Forest, where the annual dinner will be held at the Roebuck Hotel, Buckhurst Hill.

On the Friday, visits will be paid (*a*) to bookbinding and goldbeating establishments; (*b*) to the establishment of Messrs. Robert Riviere and Son; and (*c*) to the establishment of Messrs. Geo. M. Whiley. In the afternoon there will be a motor tour to various Metropolitan Water Board stations by permission of Mr. H. E. Stilgoe, M. Inst. C.E., chief engineer. The stations will include the New River Head, Kew Bridge pumping station, where there are Cornish engines by Boulton and Watt, 1808 and 1820, ditto by Maudslay, Sons and Field, 1836, and a "Bull" engine. Subsequently Kew Gardens will be visited. On the Saturday at 10 a.m. a visit will be paid to the Church Bell Foundry, established in 1570, at 32, Whitechapel-road, by invitation of Messrs. Mears and Stainbank.

A PLANT capable of making 150,000 bricks is being put up at Annieville, across the Fraser River from New Westminster, British Columbia. It is being equipped with machinery made by Whittaker and Co., of Accrington.

Railway Matters.

THERE has been preserved in the rebuilt station at Newton Abbott some of the original work done there by Brunel when the South Devon Railway was opened from Teignmouth to Newton Abbott on December 30th, 1846. Another souvenir, but of a later date, is the 0–4–0 broad-gauge tank engine Tiny, built in 1868 by Sara and Co., of Plymouth.

IT has now been intimated by Pease and Partners, the promoters, that the Bill for a private railway from Thorne Colliery to the river Ouse, mentioned in this column on December 10th last, has been withdrawn. The line was to have been about six miles in length and to have run to near the entrance to Goole Docks, where a wharf on the Ouse was to have been erected.

THE Southern Railway is carrying out a big programme at Dover, mainly out of the reconstruction of Dover Priory Station. The engine shed at the latter place is being removed to near the Marine Station. That, as related on page 129 of our issue of February 4th, has necessitated a new sea wall, which has been made into a promenade. The new road was opened on the 18th inst., and it will later be continued to Shakespeare Cliff.

AN interesting experiment in the way of lighting is being tried at the reconstructed Finsbury Park Station on the Piccadilly Railway. In the corridors leading to the station a scheme of concealed lighting has been introduced. Additional inner walls to a height of 6ft. 6in. have been built within the old subway, and, from behind cornices, concealed lights throw their rays upwards on to the white roof. A bright though diffused lighting of the subway is thus effected. The new walls have been tiled in black and white, panels being apportioned for the display of posters.

AT the annual dinner of the Railway Benevolent Institution on the 17th inst., it was stated that sixty years ago its income was only £2800 a year; now it is £124,000, and of those who had subscribed the latter sum, 214,000 were in the ranks of the railway service. Mr. William Whitelaw was one of the speakers, and he related that at a recent "all-grades" dinner, Mr. J. Bromley, the locomotive men's leader, said that the railwaymen were getting good conditions of labour, and it was the men's business to see that they gave the companies and the public good service for what they were getting.

THE discussion on May 10th on the Vote for the Ministry of Transport afforded an opportunity for Lieut.-Commander Kenworthy, the member for Hull, to raise the question of railway level crossings over roads in that city. He said that the Hull Corporation and the London and North-Eastern Railway had agreed to a scheme for the abolition of all the crossings at a cost of £1,250,000, but the Ministry, whilst approving the proposals, had refused to contribute the 66 per cent. of the cost which was asked for. In replying, Colonel Ashley said that the scheme would cost the State from £800,000 to £1,000,000, which was a very large sum for one city.

RAILWAYMEN of all ranks will welcome the fact that the new presidents of two learned bodies are members of their profession. As announced on page 559 of our last issue, Mr. E. F. C. Trench has been elected the President of the Institution of Civil Engineers. That gentleman was the engineer-in-chief of the London and North-Western Railway, and its successor the London, Midland and Scottish. From that office he resigned at the beginning of the present year, and became—and is still—the consulting engineer. Then Mr. Roger T. Smith has been elected the President of the Institute of Transport. He is no longer a railway officer, but was the electrical engineer to the Great Western from 1905 to 1924.

IN this column in our issue of January 21st, we referred to the opening of the new four-track bridge of the Central of New Jersey Railway across Newark Bay, which replaced a double-track bridge. On the latter there were two rolling lift bridges, whilst the new structure has four ordinary lift spans. There are about 218 passenger and 80 freight trains cross the bridge daily, and under former conditions freight traffic had to be suspended during the morning and evening rush hours—an exemption that has now been withdrawn. In December, 1925, the old bridge had to be opened 1400 times, but as the new bridge has been built at a higher level, so as to give a clear headway of 35ft., openings were only necessary 700 times in December, 1926.

THE Cologne correspondent of the *Manchester Guardian* states that the much-debated plan of electric railways in the Ruhr and Westphalian industrial district was discussed on the 16th inst. in Essen by Dr. Dortmuller, the Chief of the German State Railways. He pointed out that the statistics used in the furtherance of the electric railway scheme did not make it clear that fourth-class passengers represented nearly 80 per cent. of the passenger traffic in the area concerned, and that no provision was made for them in the electric railway scheme, and that therefore no support could be expected from them. He maintained that there was no necessity for the scheme, neither could it be profitable. Dr. Dortmuller also stated that the German State Railways had the intention of electrifying the section between Cologne and Hamburg in the near future.

AT the Institution of Railway Signal Engineers on the 18th, a paper on the new signalling system at Charing Cross, Cannon-street, and thence to London Bridge on the Southern Railway, was given by Mr. W. J. Thorrowgood, that company's signal and telegraph superintendent. From some statistics given in the paper it appears that in the area in question there are 65 four-aspect signals, 13 three-aspect and 89 two-aspect shunt signals. These are capable of giving a total of 516 aspects. The two all-electric locking frames of the Westinghouse Brake and Saxby Signal Company's pattern contain 225 working and 15 spare levers, and there are 114 electric mechanisms for operating points. It may be remembered that the fourth aspect is an addition to three-position, or three-aspect, signalling, and is provided to give by a double yellow light an indication that the driver has the full braking distance in which to pull up before he reaches a stop signal at "danger"; a single yellow means that the next stop signal is less than braking distance, and is at "danger."

Notes and Memoranda.

THERE are now some 20,000 steam road vehicles in the country, and they consume annually about 2,000,000 tons of coal.

THE results of some careful experiments on the transfer of heat to heavy oils in steam heaters are given in the *Bulletin* of the Engineering Experiment Station, Cornell University, for February 1st, 1927.

BEFORE an audience of about one hundred persons at a recent meeting of the Muswell Hill and District Radio Society, Mr. J. E. Roe, of the British Broadcasting Company, gave a demonstration of the R.K. type loud-speaker, which gave very impressive results. The lecturer tested a number of cone loud-speakers, owned by members, giving fairly good results, and he affirmed that it was impossible with a horn loud-speaker to reproduce the low notes properly unless the horn was some 16in. long.

WITH the view of stimulating the plumbago industry, which has been languishing of late, the Ceylon Merchants' Chamber proposes to mine new areas for plumbago. Deposits are said to occur in certain Crown lands in the Kalutara and Kellani Valley districts, which have been sold to private purchasers without mining rights, and the Chamber will approach the Government to secure mineral rights in these lands. It is believed that if the deposits in these lands are worked the industry will revive.

A REPORT containing the results of an investigation on boiler scale formation has just been issued as Bulletin 24, Mining and Metallurgical Investigations, by the Carnegie Institute of Technology. The bulletin discusses the principles of boiler water conditioning; the solubility of calcium sulphate, barium sulphate and calcium phosphate at boiler water temperatures; relation of hydroxyl ion to the inhibition of corrosion; the non-condensable gases of the steam; and the increment of soluble and insoluble solids in boiler water. Copies of this bulletin may be obtained from Carnegie Institute of Technology, Pittsburgh, Pa., at a price of 2 dollars.

THE number of furnaces in blast in this country at the end of April was 189, a net increase of 11 since the beginning of the month; at the end of April, 1926, 147 furnaces were in blast. The production of pig iron in April amounted to 680,000 tons, compared with 671,800 tons in March, and 539,100 tons in April, 1926. The production included 237,800 tons of hematite, 207,300 tons of basic, 182,500 tons of foundry, and 22,600 tons of forge pig iron. The production of steel ingots and castings in April amounted to 850,100 tons, compared with 949,600 tons in March, the decline being due to the Easter holidays. The production in April, 1926, amounted to 661,000 tons.

THE chief use of mica is in the electrical industries, states the United States Bureau of Mines, Department of Commerce. One very widespread and important use is in the manufacture of the transmitter button, an integral part of the modern telephone instrument. Mica is also used in the manufacture of lightning arresters, condensers, commutators, and many special types of equipment. In addition to its use for the glazing of stoves and furnaces, mica is employed in the manufacture of lamp chimneys. For this purpose the mica must be clear and flexible, and, generally speaking, domestic mica is suitable for this purpose. Ground mica is utilised in the preparation of rolled roofing, and a pound of mica has great covering power because of the flat shape of the thin particles. Ground mica is also used as a decorative material on wall paper and in special paints. It is occasionally employed as a facing for concrete to simulate granite. Coarsely ground material is used for decoration, and is sold under the name of Christmas-tree snow. Finely ground mica is used as a lubricant incorporated with grease, and also alone. It is also used extensively as a rubber filler.

THE Royal Meteorological Society recently issued a report on an attempt to ascertain the range of atmospherics; that is, how far away are the storms that produce the X's which interfere with reception in England. The Society, with the co-operation of the British Broadcasting Company, appointed observers in various parts of Europe, equipped with broadcast receivers and advance copies of certain talks transmitted simultaneously by the British Broadcasting Company stations, to which they listened. Whenever they heard a strong atmospheric they put a mark on the manuscript through the syllable on which it occurred. At the same time automatic direction finders in Aberdeen, London and Egypt, recorded the directions of atmospherics which occurred when the talks were taking place. When the papers were gathered and compared with the records made by the direction finders, the results were remarkable. In several cases atmospherics were observed at identically the same moment by listeners in Madeira, Ireland, Germany and Norway, and the direction finders showed that the thunderstorm responsible at the moment was situated somewhere in the West Atlantic. The results show that atmospherics may be due to storms taking place perhaps 4000 or 5000 miles away.

DURING the course of a lecture on "Wireless Transmission and the Upper Atmosphere," delivered at the Royal Institution, Dr. E. V. Appleton said that it is now becoming more and more evident that the atmosphere has a profound influence on the transmission of radio waves through it. The earliest indication of atmospheric influence was Marconi's successful transmission across the Atlantic in December, 1901. The distances previously accomplished by Marconi were so short as to be explicable on the simple hypothesis that the radio waves travelled in straight lines. But communication to America, as the late Lord Rayleigh was the first to realise, raised a new question. Could the waves bend round the protuberance of the earth, as sound waves bend round a corner? Lord Rayleigh and others investigated the problem mathematically, and their results showed that some influence other than ordinary diffractive bending was at work. We now know that this other influence is the so-called Heaviside layer of electricity in the upper atmosphere, which guides long radio waves round the earth's curvature. All recent work has tended to prove the Heaviside layer theory, and within the last two years it has been shown that the signal fading, with which many broadcast listeners are familiar, is also due to the action of this layer.

Miscellanea.

THE output of coal from Formosa is now some 2,000,000 tons a year. The imports of sulphate of ammonia are over 30,000 tons a year.

THE output of platinum concentrates in South Africa during March was 29·28 tons, and it contained 16·99 oz. of platinum per ton.

ACCORDING to the latest official report on the water powers of Canada the Nelson River alone is capable of producing nearly 4,000,000 horse-power.

THE new Nerbudda Bridge, India, is to have six lattice girder spans of 165ft. each, and two shore spans of 40ft. The height to the rail level, from the river bed, is 109ft.

A NEW company, called the Garnagara Manganese Corporation has been formed in South Africa to exploit a deposit at Klipfontein, said to contain 51·2 per cent. of manganese.

WE are informed that Mr. William J. H. Wood, M.I. Mech. E., M.I.E.E., has been appointed Engineer-in-Chief to the County of London Electric Supply Co., Ltd., following upon the resignation of Mr. Archibald Page.

ACCORDING to a Calcutta newspaper the Burma Oil Company has concluded an agreement with the Tumandar of the Bugti tribe in Baluchistan, under which permission is granted to the company to prospect for oil in the Bugti country. Wells are being sunk and the prospecting party hopes for success.

THE total capacity of water wheels in power plants in the United States on January 1st, 1927, was 11,721,000 horse-power, an increase of 544,000 horse-power for the year 1926, according to a report issued by the Geological Survey and the Federal Power Commission. This represents an increase of 7,800,000 horse-power, or an average of 460,000 per year since January 1st, 1910.

WITH a view to securing contracts for railway construction in Kirin Province, Chinese and Japanese have organised the Kirin Hing Yeh Railway Engineering Works in Kirin, the provincial capital, with a capital of about £1,000,000, shared equally between the Chinese and Japanese promoters. One quarter of the authorised capital was paid up upon the inauguration of the company.

A NEW industry, the first of its kind in Western Canada, has been recently brought into operation at Edmonton. The North-West Brewing Company has installed yeast-making machinery capable of a daily production of a ton to a ton and a-half of baker's yeast, not the brewer's variety. The plant will utilise locally produced rye and other raw products, and the alcohol which is run off as a by-product will likely be denatured and sold for industrial purposes.

GOOD progress is, according to the *Glasgow Herald*, being made with the two reclamation schemes being carried out on the long stretch of mudflats in the Forth estuary, extending from Bo'ness Distillery in the east to the mouth of the river Avon near Grangemouth on the west. The larger scheme is that undertaken by the Forth Conservancy Board, which is reclaiming 304 acres. The other scheme is being carried out by the Kinneil Coal Company with the object of providing accommodation for a battery of coke ovens and by-product plant.

THE Hamburg-American Line has placed an order with the Bremer-Vulkan Schiffbau und Maschinenfabrik Vegesack for a 17,000-ton motor passenger liner of the "Cleveland" class. The machinery will consist of four sets of six-cylinder M.A.N. type two-stroke double-acting oil engines, with a bore of 480 mm. and a stroke of 660 mm., each designed for an output of 3100 shaft horse-power at 230 revolutions per minute. Each group of two engines will be coupled to the propeller by reduction gear of the direct type similar to that which has been successfully employed on the motor ships Monte Sarmiento, Monte Olivia and Havilland. An order for a sister ship has been placed with Blohm and Voss, of Hamburg, but the type of machinery which will be installed has yet to be decided.

ON a site of about 25 acres on the South side of the Thames estuary, at Erith, Kent, a new factory is approaching completion, to which will be transferred, in the near future, a branch of industry—the manufacture of stoneware pipes for drainage—which has occupied one of the Lambeth factories of Doulton and Co., Ltd., for the past eighty years. Established in 1846, in the days when the importance of sanitation was being urged by a small band of enthusiasts, Doulton's Lambeth Pipe Works were the first in the world to be equipped for the manufacture of pipes for drainage and sewerage, and they were followed soon afterwards by other works of the firm in Staffordshire and Lancashire. Since then, Doulton's London pipes, made from stoneware clays from clayfields situated on Poole Harbour and owned by the firm, have earned a world-wide reputation. The transfer of this section of the works from the site near the Archbishop's Palace, marks another stage in the disappearance of the ancient colony of potteries which once existed at Lambeth, and of which the Doulton factories alone remain.

THE dispute which has been going on for many weeks in the Cologne Town Council, as to whether the projected new bridge over the Rhine at Mulheim shall be a suspension bridge or a straight one-span design has been settled. When the special Bridge Committee adjudicated upon the competitive designs, it recommended the acceptance of a one-span structure, without any piers in the river bed itself. This form of bridge was recommended by a majority report to the full Town Council for acceptance, but was rejected. The final decision has now been made. By 47 votes against 36 the Council, disregarding the recommendation of the Bridge Committee, has decided in favour of a "Hängerbrucke" or suspension bridge. The new bridge will supersede the unsatisfactory bridge of boats which connects the suburb of Riehl, on the left bank of the Rhine, with the great manufacturing district of Mulheim on the opposite bank. The bridge of boats was quite useless for heavy traffic, and at very low water or in time of flood had to be removed altogether. When the new structure is completed Cologne will possess four bridges over the Rhine, three of them being of the suspension type, the fourth being the familiar Hohenzollern Bridge, which carries railway, tram, motor and foot traffic.

THE WILLOW HOLME ELECTRIC POWER STATION, CARLISLE

MR. C. W. SALT, M.I.E.E., CARLISLE, ENGINEER

(*For description see page 573*)

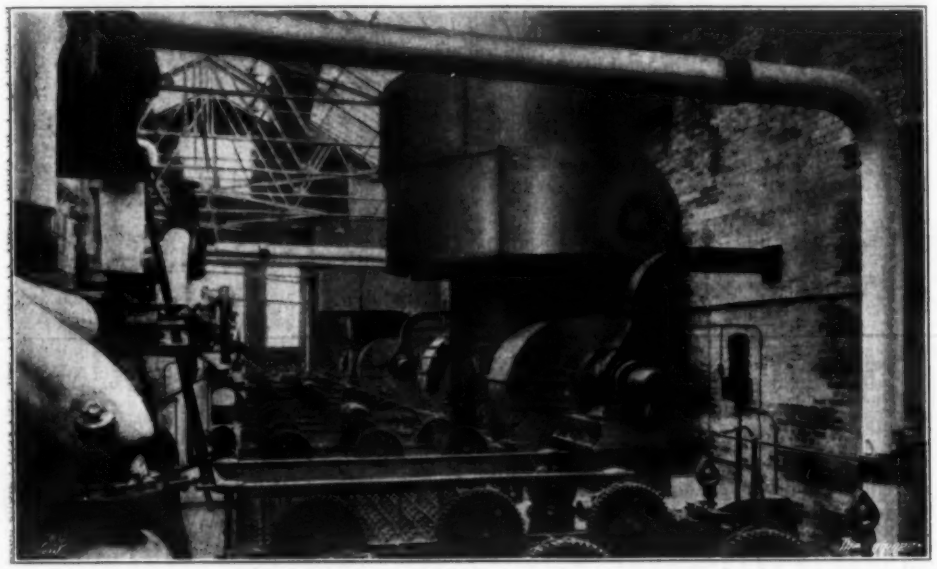


FIG. 4—ECONOMISERS AND INDUCED DRAUGHT ARRANGEMENTS

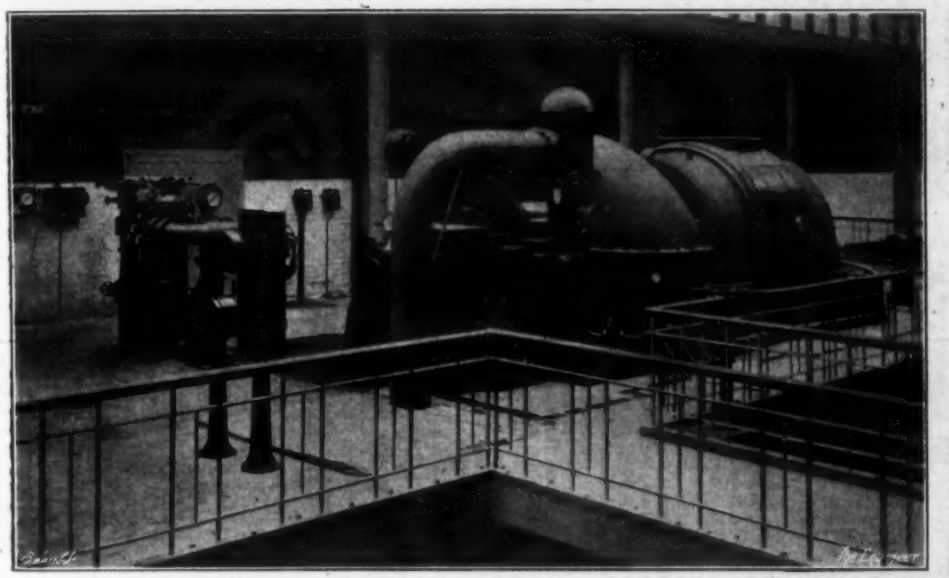


FIG. 5—6000-KILOWATT B.T.H. TURBO-GENERATOR

FIG. 6—INTERIOR OF BOILER-HOUSE

FIG. 7—CONDENSER FOR 6000-KILOWATT SET

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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist

THE MAY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE

THE ENGINEER.

MAY 27, 1927.

The Exchange in Ideas.

MOST people are acquainted with the arguments in favour of a stable foreign exchange and of the advantages of maintaining it at a point as near parity as possible, with the consequent implication of the soundness of the national credit. The financial principles involved are concerned with the giving and receiving of goods and services measured in pounds sterling or dollars, or other international units of value, but we are apt to forget that behind these considerations there are the hands and brains that produce the goods or supply the services. When we read the Board of Trade returns of exports, we can only dimly realise what anxious thought on the part of manufacturers and merchants, or what strenuous toil on the part of the manual worker has been put into that which appears in the returns as so many million pounds sterling. The designer of a machine to work in far Cathay, the captain of a freight ship pitting his seamanship against the fury of an Atlantic gale, are engaged in their respective spheres in the supply of goods and services, the romance of which is covered up by a row of figures, which may mean a great deal to bankers and politicians, but which convey next to nothing to the man in the street. He only knows, and possibly only then because it has been drummed into him from Press and platform, that we are an exporting nation, and that our national credit depends on the volume and value of our overseas trade, with which we pay for our imports of food and other necessaries. Our exports depend on our being able to compete in the world's markets in respect of price, but probably far more on our ability to meet the requirements of the overseas buyer in respect of the trustworthiness and uniformity of quality in our products. The latter is certainly true of our engineering productions, or at least it has been true in the past, that we have captured and retained markets by reason of the quality of our machinery rather than by its cheapness, and this end has been attained as much by the expenditure of thought on the perfection of detail as by the close study and application of scientific principles. To use a metaphor borrowed from the money market, the international exchange in ideas has been in our favour. The goods have been sold because the ideas that caused the masses of steel and cast iron to be shaped into a purposeful unit, have stood at a premium in the market of ideas, which, like the market in credit, knows no frontiers and owns to no nationality.

We live in a changing world, and just as the banker watches the sterling exchange, it behoves the engineer and the manufacturer to see that our reputation for resourcefulness in meeting new conditions and our reputation for the trustworthiness of our products, do not pass from being at a premium to being at a discount. There are certain tendencies at the present time which must cause anxiety to any thinking person with the welfare of our great engineering industry at heart. We referred to one recently—the number of foreign patents that are being worked in this country. No one will seriously contend that we ought to be pre-eminent in every branch of engineering. Some countries have natural advantages, as, for example, an abundance of water power which invites the exploitation of hydraulic engineering and in which greater strides may be expected than in those countries without that natural advantage. Other countries have natural disadvantages and find in overcoming them that "sweet are the uses of adversity." The inferiority in general of foreign coal, as compared with British, has, for example, led to some other countries paying more attention in the past to coal-washing plants than has been thought necessary in this country. These examples are not to say that we need be, or indeed are, behind other countries in these particulars, but that we need not be unduly anxious about developments in those departments of engineering which in other countries, for special reasons, have encountered a special impetus. What is disquieting is to find the exchange going against us in those branches for which we have a special aptitude, and in which we have excelled in the past. There is no need to multiply instances, but the problem, which is at bottom a psychological one, demands attention. What a nation, an industry or an individual thinks, that it does, and it would appear that our thinking must be in some respects less strenuous, less clear, and less direct than it was, if we are content to let other nations do the thinking for us in those branches of engineering which are British in origin, mainly British in development, and in which we ought to be able to maintain our superiority.

Those who have made a study of industrial psychology might with advantage extend their investigations beyond the worker to the higher ranks of industry. The results of such an inquiry would be illuminating, though it would have to go deeper than the effect on the thinking of a managing director of the colour of his office walls and carpet and the style of his office furniture. It might inquire whether—after attending to labour problems, meetings arising out of trade organisations, and the general routine work which modern efficiency methods have increased, if at the same time they have also simplified—enough time is left for the adequate study of the results of scientific research, and their actual or potential bearings on the industry concerned. In other words, whether the multifarious activities of modern industrial life allow those in the higher positions of responsibility to remain students to that extent which is necessary if they are to bring to their particular branch a sufficient amount of thinking and wise decision to maintain the prestige of this country. Inquiry might also be directed as to whether the increasing demands of local and imperial taxation, the claims of labour on the one hand and of shareholders on the other, leave sufficient margin for conservative finance and a reasonable provision for development by large scale experiments which are the necessary corollary of research. Such an inquiry by independent investigators is perhaps impracticable, but if it were possible, it might afford an explanation of the penetration of foreign designs in this country, by presenting to us a picture of leaders of industry, harassed by labour and taxation, seeking to retrieve the situation by the adoption of tried inventions of foreign origin. Let it be clearly understood that we do not suggest that there is anything reprehensible in the adoption of foreign patents. We have given many inventions to other countries and adopted many others from them, but to return to the metaphor with which we started, the exchange has hitherto been in our favour. If we are to maintain that position, the causes must be removed which fetter industry, and tempt manufacturers to the short cut of adopting something from abroad which, under favourable

circumstances, they could do equally well or better themselves. Two at least of these causes are labour unrest and high taxation.

The Duty of Boiler Tubes.

The whole tendency of boiler design is towards the development of tube surface. The large drums, which were formerly considered so necessary as water and steam reservoirs, have shrunk both in dimensions and in importance. So far as water reserve is concerned, an ordinary power station boiler carries between two and three times as much water in its tubes, apart from that contained in the economiser tubes, as in the drum, the function of the latter being little more than to provide an adequate disengaging surface for the steam. Moreover, far from adding anything to the heating surface, the drums of modern high-pressure boilers are carefully protected from contact with hot gases. The tubes, on the other hand, are becoming more and more important. Designers are now beginning to distribute them all round the combustion chambers in the form of water walls and water screens, where they are subjected to the most intense radiant heat and where the provision of an adequate water circulation through them is a matter of necessity. There is no doubt that the modern tendency to line the furnaces with water tubes is a correct one. The valuable heat of the furnace is the radiant heat, and it is foolish to reflect it backwards and forwards more than is necessary between costly and easily destroyed walls of fire-brick. Moreover, there is no reason to fear that combustion will not be carried out properly under such conditions. The best answer to this objection is the performance of locomotive boilers, and still more of Lancashire and Scotch boilers, where the fires are entirely surrounded by water-cooled surfaces. That an almost equally complete enclosure of the furnaces of land type boilers by water tubes will be the practice in the future is highly probable. It may, indeed, be regarded as certain when once the problem of proportioning and connecting up the tube system so as to ensure a proper water circulation has been satisfactorily solved.

In a well-designed water-tube boiler, it is possible to have an evaporation of 9 lb. of water per square foot of heating surface per hour, or, say, a heat transmission of 9000 B.Th.U. per square foot, without material sacrifice of efficiency. Very high-class boilers, maintained under the conditions that exist in the Navy, are capable of a rate of heat transmission up to 14,000 B.Th.U. per square foot. These, of course, are average figures for the whole of the heating surface, the duty of the tubes nearest the fire being far greater. What a steel tube of ordinary thickness is capable of achieving without suffering injury does not seem yet to be known. Mr. Spyer, in a recent discussion before the Institution of Mechanical Engineers, stated that he had succeeded in obtaining a transmission rate of 140,000 B.Th.U. per square foot per hour, but unfortunately gave no particulars of the experiment beyond saying that the rate could only be maintained for a few moments. The rotating tubes of the Atmos boiler, which are 0·75in. in thickness, are capable of transmitting normally about 22,000 B.Th.U. per square foot per hour. In the Sulzer boiler, designed for the same pressure of 1500 lb. per square inch, the heat transmission rate of the high-pressure tubes is about 14,400 B.Th.U. per square foot per hour. The latter result is noteworthy because of the small diameter and the length of the tubes. These tubes have a bore of only 1·8in., and are about 42ft. long and over ¼in. thick. As every tube has to generate about 330 lb. of steam per hour, it must produce enough steam to fill its own volume completely in less than 2½ minutes. This steam has to travel an average tube length of 21ft. and to get away quickly enough to leave the tube walls in practically continual contact with solid water. It is this problem of getting the steam away from the heating surfaces which is really at the root of all the difficulties in connection with high-duty boiler design. Every attempt to utilise the radiant heat of the fire to its fullest extent necessarily involves high evaporation rates and the extension of the tube surface round the furnace walls for the same object complicates the circulation system to a very considerable degree. So long as differences of density are relied on to start and maintain circulation in boilers, care should be taken to make the work of the small circulating force as easy as possible. Uniform velocities along each tube circuit, easy bends where directions are changed, and other commonplaces of hydraulic engineering might with advantage be given much more consideration than they usually are. The conditions in high-duty boilers are much more severe than in the old days of easy steaming rates.

As Mr. Stromeyer remarked in his last annual "Memorandum" to the Manchester Steam Users' Association, makers of water-tube boilers are gradually realising the fact that the evaporation in tubes exposed to the radiant heat of the furnace increases practically in proportion to the fourth power of the absolute temperature of the fire. With excess air cut down to the minimum and high rates of combustion on the grates, the temperature at the fuel bed may be as high as 2800 deg. or 2900 deg. Fah., and the radiant heat correspondingly intense. If the fuel bed and the brickwork were at the same temperature, and the whole furnace subject to the ideal conditions of "black-body" radiation, it would be theoretically correct to say that the heat received by the tube surface was proportional also to the ratio between this surface and the rest of the furnace. With this fact, possibly, in his mind, Mr. Stromeyer states that the evaporation in tubes exposed to the furnace depends also on the ratio of the fire surface to the heating surface. "Thus," he says, "the shorter the first-row tubes, the intenser their ebullition," and he draws the conclusion that "the steam generated in any pipe is independent of its length." If this were so, his further deduction that "if in a 15ft. pipe the steam bubbles occupy 25 per cent. of the length, in a 7½ft. pipe they would occupy 50 per cent., but the larger the steam bubbles, the less water contact will there be, and the greater the chances of overheating" would follow. But we doubt very much whether the premises of the argument are even approximately true in practice. Instead of saying that the steam generated in any pipe was independent of its length, he might just as logically have said that it was independent of its diameter, for by halving the diameter the ratio of fire surface to heating surface can be just as effectively doubled as by halving the length. But this argument he does not admit. On the contrary, he maintains that if the diameter is halved, steam production is halved, but as the sectional area of the tube is thereby reduced to a quarter of its original size, the length of the steam bubbles will be increased from 25 to 50 per cent. Experience, he holds, supports his view, and "small-sized boiler tubes have gone out of fashion." Whether they have or not is a matter of opinion, but Mr. Stromeyer's point that the presence of a given volume of steam bubbles in a comparatively small boiler tube is more serious than in a large tube is a good one, and we have shown above in connection with the Sulzer boiler how arduous the conditions might become. There is also a danger, as he points out, of stationary bubbles forming in tubes, particularly when the circulating velocity is high. Any irregularity in the tube, such as a slight bulge or a piece of irregular scale, will tend to set up an eddy, and a stationary bubble may be formed where the pressure is lowered by the eddying motion. Experience seems to show that there is a distinct possibility of tubes failing by overheating caused by stationary bubbles, and Mr. Stromeyer suggests that there may be a best velocity of circulation in boiler tubes which should not be exceeded.

Obituary.

ARCHIBALD W. CAMPBELL.

A message from Canada states that Mr. Archibald W. Campbell, Dominion Commissioner of Highways, died suddenly at Ottawa on May 9th from heart failure. Mr. Campbell, who was in the sixty-fifth year of his age, was born at Wardsville, Ont. He graduated in engineering in 1885, and became city engineer of St. Thomas, Ont., in 1891. He was one of the earliest advocates of the "Good Roads Movement," and his activity in its promotion made him known as "Good Roads Campbell." In the construction of highways he was an expert, and he was appointed Good Roads Commissioner for Ontario as long ago as 1896. Four years later he became Deputy Minister of Public Works in the Ontario Government, and in 1910 he went to Ottawa, having been appointed as Deputy Minister of Railways and Canals, and Chairman of the Railway Managing Board. At a later date Mr. Campbell became Commissioner of Highways, and had since occupied that position. His reports on roads and streets have become text-books in the hands of road-makers, and he was regarded as one of the most reliable authorities on the matter in America.

ERNEST SAMUELSON.

We regret to have to put on record the death of Mr. Ernest Samuelson, which took place on Friday of last week.

Mr. Samuelson, who was in his seventy-first year was the son of the late Mr. Alexander Samuelson, and was born at Kingston-on-Hull. He received his education at King's College, London, and in 1878 went to Banbury to join the firm of Samuelson and Co., of which Mr.—later Sir—Bernhard Samuelson, his uncle, was then head. All his business life was devoted to that company. Prior to 1905 he was for some time joint managing director with the late Mr. J. P. Hardy, and in that year he became managing director, a post which he continued to fill until he retired a year or so ago.

Mr. Samuelson was a member both of the Institution of Civil Engineers and of the Institution of Mechanical Engineers, as well as of the Royal Agricultural Society. He will be greatly missed in Banbury, as he took a keen interest in everything which concerned the neighbourhood, especially the Volunteer and, subsequently, the Territorial Movements. He was made Justice of the Peace in 1894 and was High Sheriff of Oxfordshire in 1921.

Literature.

The Natural History of a Savant. By Professor Charles Richet. Translated from the French by Sir Oliver Lodge. London: J. M. Dent and Co., Ltd. 1927. Price 5s.

There would be only one way to review this pleasant little book—to discuss critically Professor Richet's anatomy of the scientist. From that course we beg leave to be excused. Indeed, we do not much mind whether the eminent author is right or wrong; his book still charms us by the delicacy with which it is written, its little turns of wit, its thumb-nail sketches of eminent scientists, its familiarity with literature, its enthusiasm for those beloved and admired, even its national and personal egoism. It has, too, been kindly handled by Sir Oliver Lodge. We speak without knowledge of the original, but just as one may say of a portrait of an unknown person, "That must be like him," so we may say of this translation that it must be like the original.

Professor Richet is a physiologist and adores that science; on Anatomy, its sister, he looks with tolerant disdain. Is it not an exhausted science? There is nothing more to be learnt. It is a pity that really great men should waste their time on it. But Physiology! She is the queen of all the sciences. We may suspect that in his heart of hearts he puts engineering in the same company as Anatomy—just mechanism. Not a science for a true savant; not offering much scope for imagination. It is not "pure" science. It has ulterior objects, and is therefore on a lower plane. He is tolerant to it, but no more. But upon pure science he grows eloquent. "The future and the happiness of humanity," he says in italics, "depend on science. So much the worse for society if it fails to apprehend this outstanding truth." We may wrong him, but he has so little to say of engineers that we venture that guess at his attitude towards them.

Of his few chapters we like best that entitled "Some Real Savants." It is here we find the thumb-nail sketches to which we have alluded of scientists he had known — Marey, Berthelot, Vulpian, Poincaré, Pasteur, and so on. Here he does not discuss their work; he shows them to us in a few bold sketches as men. If you are not deeply interested in the Lepidopteræ, it is when the entomologist ceases to number the joints in their *palpæ* and invites you to marvel at the wonderful colours of their wings that he becomes most attractive. So, when Professor Richet ceases for a time to dissect and anatomise the savant, and shows us what he is really like before he is taken to pieces, it is then that we like him best. Yet there is not a dull page in this little volume; one may read it comfortably over the fire, and put it down where someone else may pick it up to enjoy in his turn.

SHORT NOTICES.

Controllers for Electric Motors. Second edition. By H. D. James. London: Chapman and Hall, Ltd. Price 21s.—The fact that this book deals with American practice—the material for the first addition having appeared in the *Electric Journal*—may possibly restrict its use in this country, but it is to be remembered that quite a few control systems employed and made by British engineers are more or less of American origin. In any case, there is a great deal in the book that does not relate to any particular design, such, for example, as the elementary chapters that have been included for the benefit of persons who have not had much experience with control apparatus. Moreover, whilst some American control gear may differ slightly from that made in this country, the same fundamental principles are involved, and on the whole the fact that the author deals with American practice is not a great disadvantage. The object of the volume is to bring together sufficient information on electric control to give a general idea of its designs and operation, and the book is intended for technical students, operating engineers, purchasers and users of electrical apparatus, a noteworthy feature being that most of the diagrams are of a simple and elementary nature. Those who are engaged in the electrification of factories and other industries establishments, and who desire to gain information on the control of different types of motors working under different conditions should find the volume useful, for it covers a wide field and is written on practical lines.

Powerful Steam Cultivating Machinery for Italy.

IN order to assist the Italians in their efforts to bring the rather desolate areas of the Roman Campagna to a higher state of cultivation than has hitherto been obtained, John Fowler and Co. (Leeds), Ltd., have recently built several sets of steam cultivating machinery on the cable system which are much more powerful than anything hitherto attempted by them.

Before describing this plant, however, it will be well to state something of the movement which has been the means of bringing these plants into being. Some little time ago Signor Mussolini and his supporters introduced a new movement called the *Battaglia del Grano*—the "battle of the grain"—with the object of increasing the production of cereals throughout Italy in order to make the Italians more independent of foreign supplies of wheat. As is well known, a large part of Italy is mountainous and unsuited for growing cereals, and practically all the land in the valleys is already under cultivation, so that there was little scope for increasing the area under crop and most of the efforts were directed towards increasing the returns obtained from the land. The first season's operations resulted, we are informed, in very definite improvement, but the Roman Campagna proved an exception, because for centuries the land had been very little used for arable cultivation and had been given up mainly to the pasturing of sheep. It should be stated that the soil is of volcanic origin and very finely divided, so that after many years of sun and rain it has hardened below the surface almost into rock and the subsoil has become impervious to the passage of the sun's rays. As a result, the rains of winter being unable to soak into the ground, morasses form in the flat and low-lying parts, while in summer the moisture is entirely evaporated by the heat of the sun and vegetation dies off completely.

It has been found, however, that cultivation to a depth of 30in. obviates this unfavourable state of affairs and that if the hardened subsoil is brought to the surface it "weathers" down in the sun and rain, forming a very fertile soil for many kinds of crops. This work, as can well be imagined, is extremely heavy and necessitates the use of ploughing machinery of exceptional power and rigidity. A number of plants were purchased by the Italian Government during the war, and others have been purchased by private enterprise and companies since that time with the aid of Government subsidies. The engines are capable of developing 250 horse-power and over, while the ploughs tear up the rocky soil into lumps weighing sometimes several hundredweights each, and these have to be further broken up by hand hammers to assist the weathering process. The effect of the use of these engines has resulted, we are informed, in greatly improved crops, while the disease known as "Roman fever" due to the prevalence of large areas of stagnant water has disappeared in the Campagna almost entirely.

A view of one of these ploughing plants is given in Fig. 1, from which a good idea of the depth and arduous nature of the work can be obtained, while Fig. 2 is a drawing showing a side elevation, and on page 582 there is a general view of the engine. This engine is of the firm's latest design and embraces several quite new features, one of which is a superheater which is built on very accessible lines, so that it can be dismounted, cleaned, and replaced in less than two hours. The position of the superheater in the smoke-box is clearly shown in the drawing. The headers are fixed on the smoke-box sides and the superheater tubes pass inside the boiler tubes. Another new feature of this engine is the ploughing gear, which has been designed to obviate the troubles which have sometimes occurred owing to the expansion of the boiler throwing the upright shaft out of the perpendicular. In the new design this shaft is of massive proportions, and of high quality steel. It is provided with an independent clutch socket, which, together with the drum pinion, revolves in a special foot-step bracket. The socket is fitted with a self-aligning ball bearing which carries the upright shaft for the purpose just referred to. With this new arrangement the drum pinion and socket can be removed without disturbing the bevel gears or crank shaft.

The leading particulars of this engine are:—Overall length, 25ft. 6in.; overall width, 10ft.; overall height, 13ft. 10in.; hind wheels, 7ft. by 2ft. 6in.; front wheels, 5ft. 6in. by 1ft. 8in.; bunker capacity, 21 cubic feet; tank capacity, 255 gallons; working pressure, 200 lb. per square inch; and maximum continuous indicated horse-power under ploughing conditions, 275. Engines for this class of work must have ample steam generating capacity for long sustained tractive effort, and in this respect the Fowler engine complies with the most drastic requirements, as will be observed from the tests referred to later. The heating surface and grate area are proportioned for this purpose, and the spaces between the fire-box and the fire-box shell are of extra width to make the boiler specially suited for use with bad water. Tell-tale holes are provided in the fire-box screwed stays, wash-out holes in the top of the shell in the fire-box sides, and in the front portion of the barrel. The smoke-box is fitted with a specially long forecarriage mounting and the pin of the forecarriage is strongly stayed. The engine is of the compound pattern, the cylinders being steam jacketed, and piston valves are employed. The valve gear is of the radial type. The crank shaft is forged from a steel ingot, the cranks being cut from the solid. It is fitted with balance weights and is supported by one centre and two outer bearings. Dust covers are fitted for the motion work. The winding drum is of cast steel with a renewable gear ring. It is fitted with an automatic strap brake, by which the speed of revolution of the drum when paying off the slack rope can be controlled.

The following are the details of a fuel and water consumption test carried out on one of these engines at the company's works, Leeds. They were made with a water-cooled friction dynamometer brake under conditions approximately similar to those which would be encountered when ploughing, *i.e.*, four minutes on full load with intervals of five minutes for stops to allow for reversing and the return passage of the plough. The number of "bouts" was twenty-seven, which gave, approximately, a four hours' test. At each bout indicator cards were taken from both high and low-pressure cylinders. The steam and gas temperatures, both at the exit from the boiler tubes and the entrance to the chimney, were taken one minute and three minutes from the commencement of each bout, and the crank shaft revolutions were measured by a counter and a tachometer. At the end of the trial the coal and water were accurately measured. The results are given in the table on page 582.

FIG. 1—STEAM PLOUGH IN OPERATION ON THE ROMAN CAMPAGNA

The following are the chief particulars of the plough:—Working depth, 80 cm. (31½in.); width of furrow (adjustable), 24in. to 28in.; furrow wheel, 7ft. 6in. diameter by 9in. wide; land wheel, 5ft. 6in. diameter by 15in. wide; skid wheel, 24in. diameter by 5in. wide.

The share is made in two pieces so as to reduce the cost of replacement in case of wear or breakage. Besides the share, the plough body is fitted with a bar point which lies alongside the nose of the share to take the heaviest part of the load at that point. This bar point is made of special high-tensile steel, 1¼in. square, and can be quickly replaced and re-sharpened when it becomes worn. The s e d on the plough body is also made in two pieces, the lower part, where the greatest wear takes place, being made of rolled steel angle section, while the upper part is of cast iron. The mould board is also made in two pieces for the purpose of reducing the cost of replacements.

These special arrangements are very necessary for work in Italy, not only because the land is so hard that sometimes it is nearly a question of ploughing up rock, but also

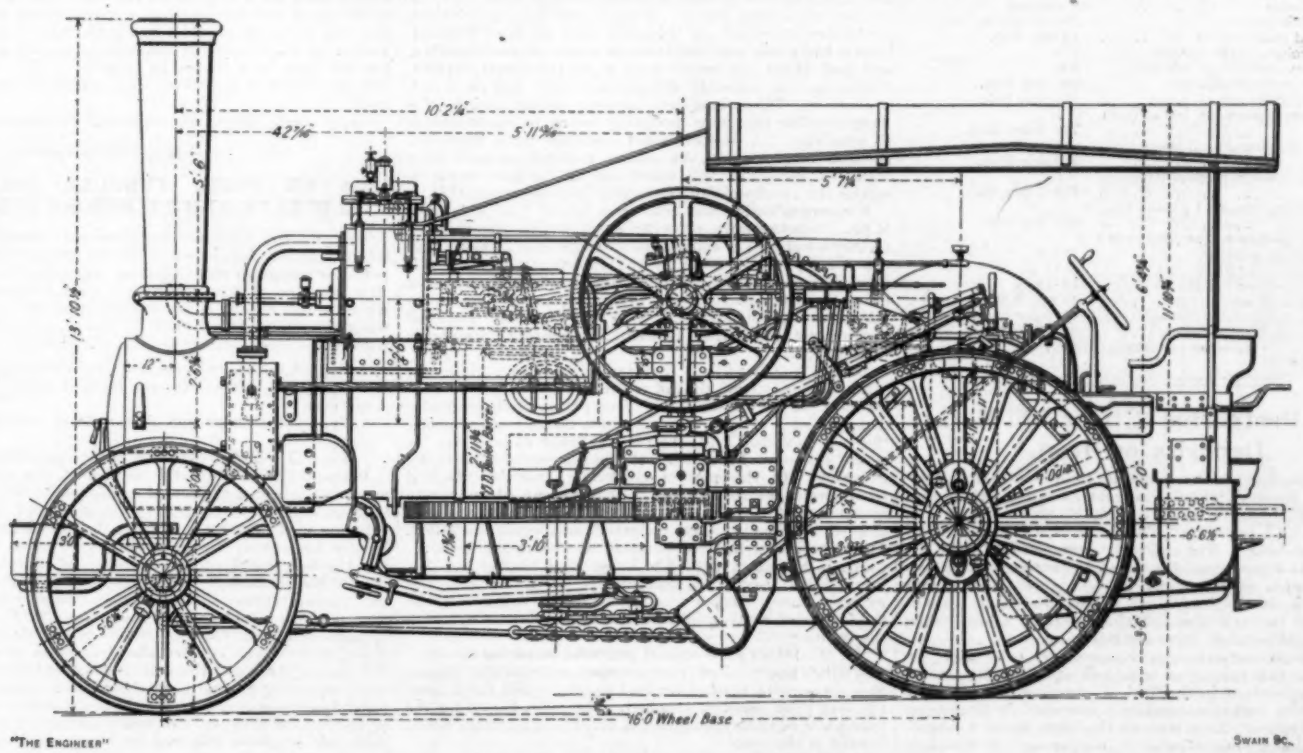
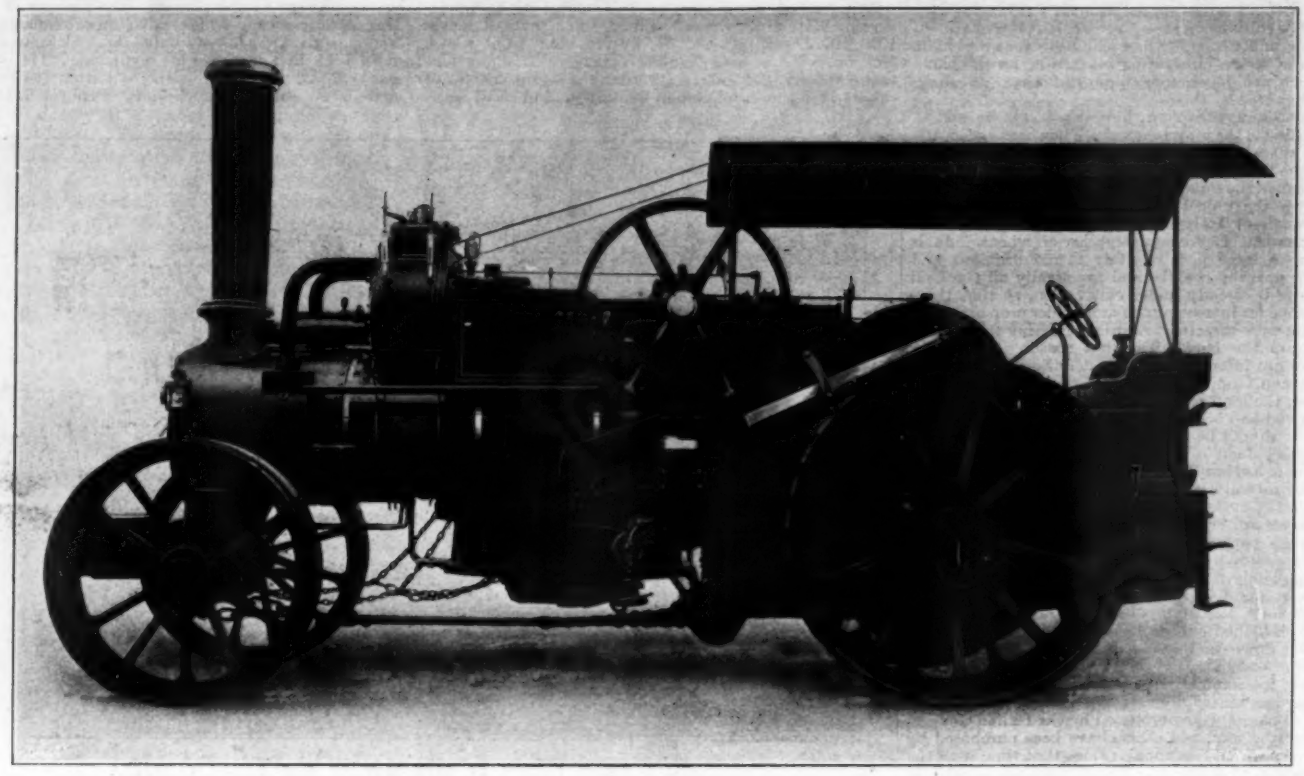


FIG. 2—275 H.P. FOWLER STEAM PLOUGHING ENGINE

275 H.P. STEAM PLOUGHING ENGINE

JOHN FOWLER AND CO., LTD., LEEDS, ENGINEERS



because the wear on the various parts produced by the soil is much more than is usual, so that the cost of replacements assumes a greater importance in consequence.

On the land side of the frame at each end is fitted a lifting strut, as can be seen in the illustration—Fig. 1. When this strut is thrown over the foot of it takes a grip on the ground as the plough moves forward and lifts the plough body gradually out of work.

Particulars of Test.

Duration of test	4 hours 3 minutes
Number of bouts	27
Duration of one bout	*4 minutes
Duration of stop	*5 minutes
Average boiler pressure	200 lb. per sq. in.
Average feed temperature	48 deg. Fah.
Average revolutions per minute	275
Maximum revolutions per minute	300
Average temperature of steam	620 deg. Fah.
Maximum temperature of steam	668 deg. Fah.
Average temperature of gases (tube ends)	788·9 deg. Fah.
Maximum temperature of gases (tube ends)	900 deg. Fah.
Average temperature of gases (chimney bottom)	749·5 deg. Fah.
Maximum temperature of gases (chimney bottom)	850 deg. Fah.
Indicated horse-power developed at 300 revolutions per minute	274·6
Weight of coal per I.H.P.	2·14 lb.
Weight of water per I.H.P.	14·23 lb.
Calorific value of coal	14,000 B.Th.U. per lb.
Efficiency of boiler and superheater	62·5 per cent.
Amount of superheat	232 deg. Fah.

* As under ploughing conditions.

The Protective Effect of Metal Deposits on Iron.

At a meeting of the Electroplaters' and Depositors' Technical Society, which was held at the Northampton Polytechnic Institute on Wednesday, May 18th, Mr. S. Wernick read a paper on "The Protective Effect of Metal Deposits on Iron." The chair was occupied by Dr. W. H. Vernon. The paper was illustrated by lantern slides showing the action of salt spray on test pieces coated with such metals as zinc, cadmium, nickel, chromium, cobalt, copper and tin, and also contained various tables giving experimental results, corrosion data, &c.

Dr. Vernon, introducing the speaker, said that the problem of the rusting of iron was undoubtedly one of the most important in the field of corrosion, owing to the fact that the corrosion actually accelerated as time went on. With copper, there was, on the other hand, a retarding effect, and thus articles in copper and bronze had survived long after those of iron had completely disappeared. Iron was so extensively used that any method which would effectively protect it was worth very close study.

Mr. Wernick, in opening his paper, said that the three important factors which affected electro-deposition for rust protection were (*a*) the nature of the protective metal; (*b*) the thickness and condition of the deposit; and (*c*) the conditions under which it had been deposited. So far as the first two points went, a useful guide was found in applying Nernst's solution pressure theory and the normal potentials of the metals commonly deposited. The same theory gave a good picture of the mechanism of the rusting of iron. It was thus seen that, theoretically, of the metals which had been deposited, only zinc, chromium, and possibly cadmium could be expected, by acting anodically to the iron, to act as rust preventives. The conditions of deposition were, however, extremely important factors; such factors as the preliminary treatment, porosity of the base metal, structure of the deposit, type of solution used, throwing power of the solution, mode of handling and the final finish all entered into the production of an efficient deposit. The throwing power of a solution was particularly important in the case of articles with sharp bends or deep recesses. That fact, together with the fine structure obtainable from cyanide solutions, accounted for the marked superiority of these baths over acid sulphate solutions in the case, for example, of zinc. Electrolytic zinc was superior to zinc deposited in any other way, on account of its great purity. Nickel could act as an efficient protective provided its thickness was at least 0·001in. Cobalt had given very good results with a copper underlay, and had stood up better than a copper-nickel deposit. Cadmium was certainly comparable with zinc as a rust preventive. Chromium gave varying results, mainly of a disappointing character, probably owing to its proneness to passivity. A copper-nickel underlay gave improved results. In conclusion, the author stressed the need for a standard corrosion test which should be laid down to render the results of different investigators comparable.

A communication was read from Mr. T. Henry Turner, M.Sc. (Birmingham), drawing attention to the unsatisfactory condition of modern commercial electro-plate, and the consequent increase in the specifications for "all-black" finishes. He heartily supported the suggestion for a standard corrosion test, which, he proposed, should be taken up in collaboration with the National Physical Laboratory and the British Engineering Standards Association.

Mr. E. A. Ollard said that failure of electro-plate was rather different from that of ordinary metal. He outlined three types of failure:—(1) The plate itself gradually disappeared; (2) pits formed which opened out, causing the rust to spread; (3) the plating broke clear away. It would therefore be difficult to obtain corrosion data by weighing. In the case of chromium, porosity resulted from strains in the deposit. An underlay of copper to nickel was not such good practice as a coat of nickel treated anodically, then coppered and again nickelled. The adhesion of this combination was extremely good.

Mr. L. P. Sidney wished to know what kind of iron Mr. Wernick had used in his experiments, whether it was pure wrought, ingot, Armco or mild steel. He suggested that the failure of bends might be due to the strains set up in the bending.

Mr. W. James gave several practical instances of corrosion which had resulted from porosity, and said that platers were frequently blamed for bad results which arose from the very poor material supplied. The main reason for the poor plate of to-day was the cut-throat competition which existed in the trade.

Mr. L. Wright, referring to the porosity of chromium plate, said that he had found that the chromic acid entered the deposit, and was retained after the polishing process had "flowed" the surface. On removing this layer the acid could be detected. In addition to the protection derived from the deposited metal, there was often an additional protection arising from the corrosion product formed.

Mr. S. Field said that heavy lacquers certainly increased the life of a deposit, but that their object should be to get a plate which would not require a lacquer. With regard to porosity, even the smallest pore had been shown by J. R. Evans to set up corrosion. Electrolytic zinc had a considerable advantage over galvanised zinc in its purity. The latter after use often contained 4 per cent. of impurity, mainly iron or lead. A standardised salt spray was perhaps not the ideal corrosion test. Tests which were more in accord with atmospheric conditions, covering a longer period would probably be used later.

Mr. H. Perring suggested that a cyanide zinc coat followed by sulphate zinc to cover bends, still rendered the latter the "weakest link in the chain."

Mr. P. J. Craddock gave details of the "close plating" process which was considerably thicker than electro-plate and effectively closed up pores. It had been known to act as a protection for upwards of twenty years.

The Chairman, in closing the discussion, pointed out that an important factor in the life of a deposit was the conditions under which it was to be used and the tests should have some relation to this fact. Mr. Wernick was evidently of the opinion that a concentrated atmospheric test was the most reliable, and with that he agreed. He wished to know how far oils had been used as a finish; lanoline had been shown to be very useful. The oxide film on metals was probably as important as the metal itself.

Mr. Wernick then briefly replied to the discussion.

IRON OR STEEL TUBULAR POLES FOR TELEGRAPH AND TELEPHONE PURPOSES.

The British Engineering Standards Association has recently issued B.S. specification for iron or steel tubular poles for telegraph and telephone purposes, No. 134, 1927. This new specification deals in a very complete manner with the full details of the construction of iron and steel telegraph poles, four types of which are recognised as standard. These four types are as follows:—

Type A.—Tapered tubular pole in two or three parts.

Type B.—Riveted (seam) tapered pole in multiple sections.

Type C.—One or two-piece pole in reduced parallel steps.

Type D.—Multiple-section pole in parallel steps.

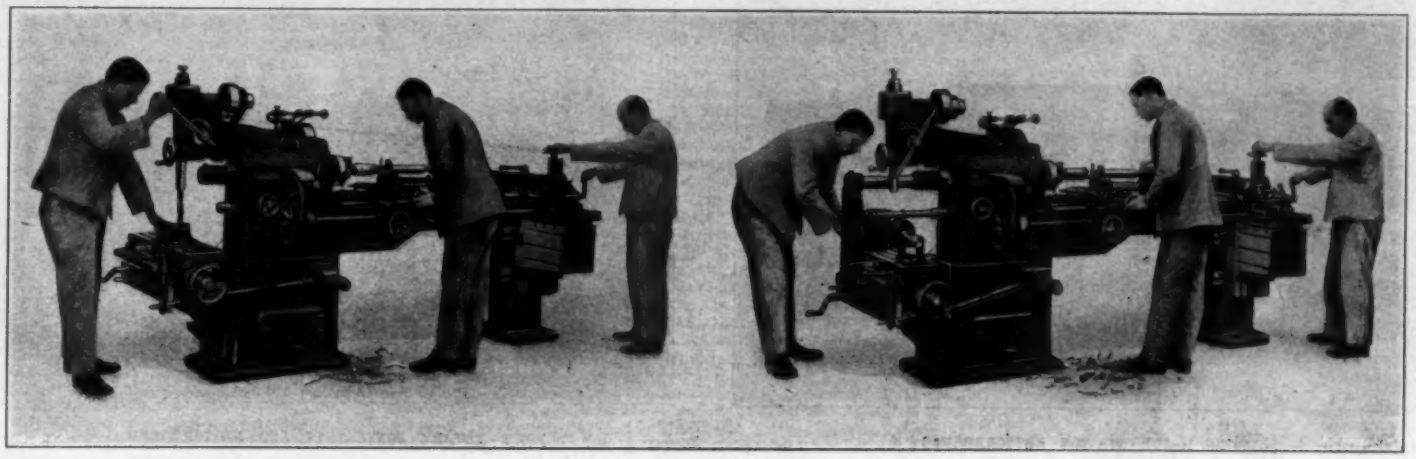
Perhaps the most useful feature of the specification, apart from the constructional details, is the list of standard lengths and test loads, these lengths and loads being common to all four types of pole. Inasmuch as the overall lengths necessarily vary slightly according to the type of construction employed, a number of nominal overall lengths has been adopted as the basis of comparison between the various types. These lengths range from 18ft. to 44ft., and the crippling loads range from 300 lb. to 2200 lb. applied 6in. from the top of the pole. After giving a description of the constructional features of each type, the general clauses of the specification explain the assumptions regarding ground resistance, which have been made for the purposes of calculating the test weights. A schedule of mechanical properties of and calculated stresses in the materials is given, followed by clauses dealing with the means to be employed for protecting the component parts of the poles from corrosion.

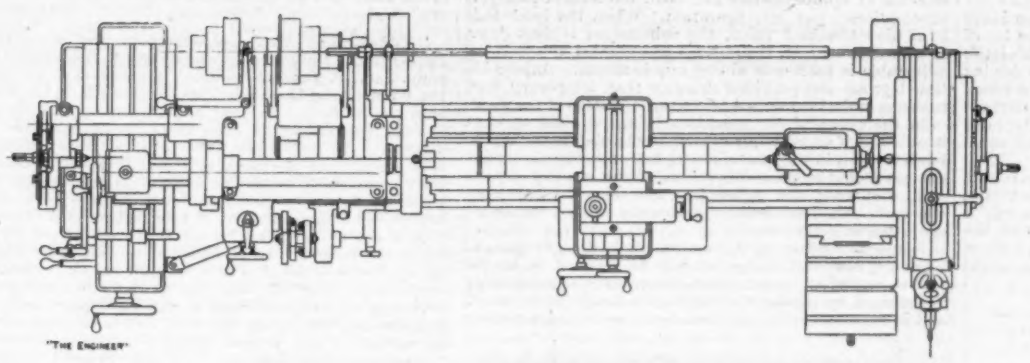
The sectional clauses, dealing specifically with each particular type of pole, give full details of the methods of testing the poles and their bases, if any, together with very complete drawings and tables of dimensions of the component parts of the poles and of the accessories used with the poles, *e.g.*, bases, final spikes, buckled plates, ground plates, shoes, caps, &c. The drawings and their appropriate tables are conveniently arranged on folding sheets, and the specification is bound in cloth, thus affording adequate protection to the folding sheets.

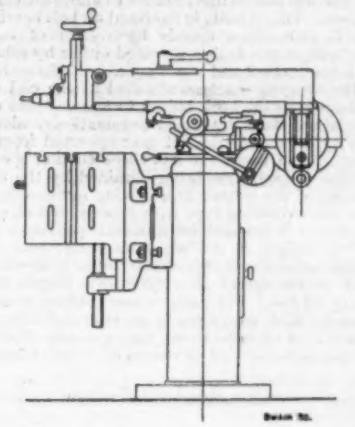
The specification is bound in cloth, and copies may be obtained from the publications department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 10s, 6d., post free 11s.

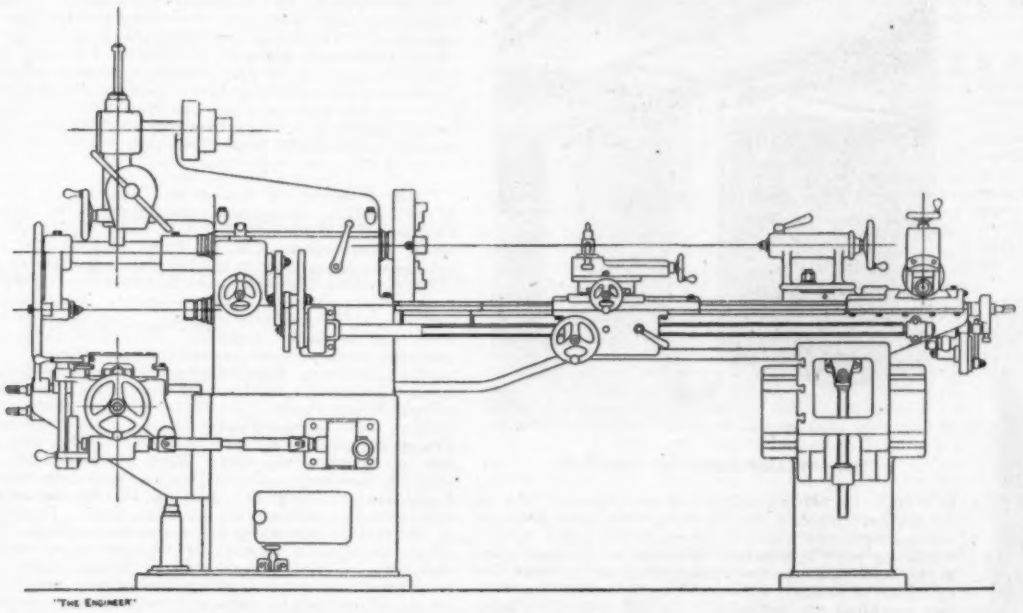
COMBINATION MACHINE TOOL

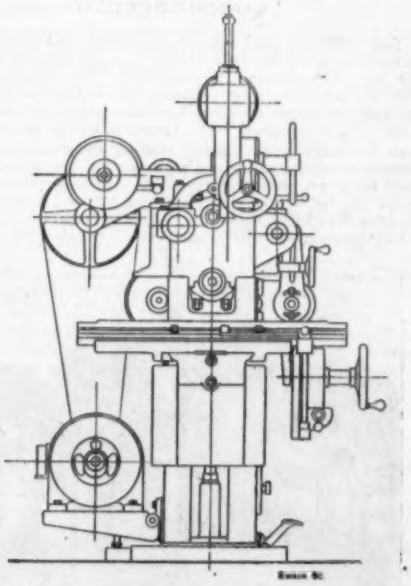
THE ZBIROWER EISENWERKE MAX HOPFENGÄRTNER A.G., HOLOUBKOV, CZECHOSLOVAKIA, ENGINEERS











Combination Machine Tool.

AT the recent Commercial Fair in Prague a machine tool of an unusual kind was exhibited by the Zbirower Eisenwerke Max Hopfengärtner Actien Gesellschaft, of Holoubkov, Czechoslovakia. The tool in question, which we illustrate in the above engravings, is a combination machine designed to fulfil the functions of a lathe, a milling machine, a shaping machine, and a drilling machine. The turning and shaping operations are quite independent of each other and can be carried on simultaneously with either drilling or milling, so that three separate pieces of work may be machined in different ways at the same time. Reference to the illustrations will show that the lathe bed is constituted as a sort of bench extending from the back of a milling machine standard and cast solid with it. An overhanging bracket bolted to the top of the standard carries the gear for the drilling head. When drilling is being done milling operations cannot be carried out, as a common work table serves for both those functions. The shaping head works on a slide which can traverse longitudinally along the lathe bed, the drive being by means of a back shaft and slotted link motion. The power required for the whole machine is about 2·5 H.P. This power is provided by an electric motor behind the main standard, but, alternatively, a belt drive from an overhead shaft may be employed.

The main dimensions of the various parts of the machine are given in the following table :—

Lathe :	
Height of centres	180 mm. (7·1in.)
Distance between centres	1000 or 1500 mm. (39·3 or 59in.)
Bore of spindle	32 mm. (1·26in.)
Width of bed	300 mm. (11·8in.)
Diameter of face-plate	340 mm. (13·4in.)
Maximum diameter of work over bed	360 mm. (14·2in.)
Maximum diameter of work over saddle	210 mm. (8·3in.)
Maximum diameter of work in gap	500 mm. (19·7in.)
Maximum length of work in gap	180 mm. (7·1in.)
Milling machine :	
Length of table	700 mm. (27·6in.)
Breadth of table	200 mm. (7·9in.)
Longitudinal motion of table	400 mm. (15·7in.)
Transverse motion of table	180 mm. (7·1in.)
Vertical motion of table	350 mm. (13·8in.)
Shaping machine :	
Maximum length of stroke	250 mm. (9·8in.)
Maximum length of traverse	750 mm. (29·5in.)
Maximum height of traverse of table	350 mm. (13·8in.)
Length of table	280 mm. (11·0in.)
Width of table	280 mm. (11·0in.)
Drilling machine :	
Maximum diameter of hole	26 mm. (1·02in.)
Maximum depth of hole	100 mm. (3·93in.)
Maximum height of work	250 mm. (9·8in.)

The machine is built with two lengths of bed, allowing respectively the maximum distances between centres given in the table. When work requiring centres at these distances is being turned the shaping machine cannot be used at the same time. Conversely, when the shaping machine is required to work with its maximum traverse of 750 mm. the lathe has to be out of action. Except for these limitations the lathe may be operated simultaneously with the shaper, the possible length of work between centres being naturally reduced, according to the desired traverse of the shaper. The use of the drilling or milling part of the machine is, as has been mentioned, quite independent of that of the turning or shaping operations which may be carried out at the same time. The lathe has a gap bed which materially increases the size of work that can be accommodated. The mandrel is hollow, with a ball bearing to take axial thrust, and it has six speeds of rotation. The poppet head has a cross adjustment for turning slight tapers. The saddle is equipped with a fully-compounded swivelling slide rest and with an apron of box section. Change wheels are provided for cutting both metric and inch threads, and there is in the saddle an indicator for facilitating the cutting of odd pitches.

The milling machine has a spindle independent of the lathe, bored to No. 3 Morse taper. It has six speeds. The table has longitudinal automatic traverse at three speeds, its vertical and cross traverses being operated by hand. The overhanging arm supporting the arbor is off

THE ENGHAVEPLADS AUTOMATIC SUB-STATION, COPENHAGEN

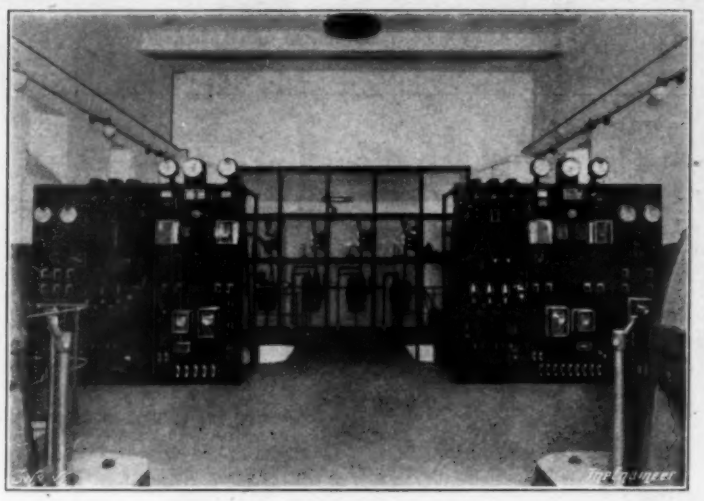


FIG. 1—SUB-STATION SWITCHBOARDS

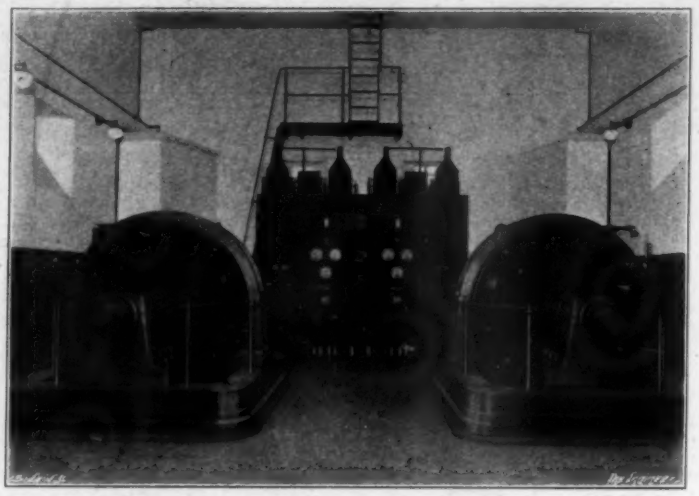


FIG. 2—ROTARY CONVERTERS AND SWITCHBOARD

the vertical centre line in order to allow the drilling spindle to pass. This spindle is mounted on ball bearings and provided with three speeds by means of cone pulleys. The feed of the drill is operated either by a hand lever or by a hand wheel and worm gear.

The shaping machine situated at the end of the lathe bed operates on work bolted to a knee table on the leg of the lathe. It is traversed automatically along the lathe bed by a variable ratchet gear operated from the driving shaft at the back. It has three cutting speeds, a quick reverse in each case being obtained by the characteristic motion of the slotted link driving mechanism. The head is of the swivelling type with graduated dial, and the usual hand feed of the tool downwards is provided.

The weight of the whole machine, with a maximum length between centres of 1000 mm., is about 26 cwt., and that of the larger size, 1500 mm. length of centres, is about 28 cwt. For garages and jobbing shops where the machine tool equipment is necessarily limited, and where space is a consideration, the machine illustrated might render useful service by reason of its universality.

An Automatic Sub-station in Copenhagen.

THE difficult problem of providing sub-stations in residential parts has been solved in a satisfactory manner by the Copenhagen Municipality. The illustration—Fig. 3—shows the Enghaveplads sub-station, which, from an æsthetic point of view, has been made to harmonise with its surroundings. The round pillar on the right, it may be mentioned, is a bill posting station, and it constitutes another example of how an often unsightly feature may be given an attractive form. The electrical equipment of the sub-station, supplied by the Metropolitan-Vickers Electrical Company, includes two 1000-kilowatt rotary converters, with transformers, which serve for con-

FIG. 3—THE ENGHAVEPLADS SUB-STATION

verting 6000-volt three-phase 50-cycle supply into direct current, at pressures of 440 and 220 volts, for distribution on a three-wire lighting system.

The lay-out of the equipment is clearly shown in the illustrations—Figs. 1 and 2—the transformers—see Fig. 4—and part of the switchgear being accommodated in the basement beneath the remainder of the high-tension apparatus. The automatic equipment controls the connections to two incoming high-tension feeders, the complete operation of the rotary converters, and the output connection to the direct current bus bars. Power for the control circuits and for closing the electrically-operated circuit breakers is taken from the direct-current bus bars, which are connected directly to the network, but provision is also made for automatically transferring the control circuits to another source of supply in the event of the bus bar supply failing.

Normally the sub-station is supplied by one of the high-tension feeders, the other feeder serving as a spare, and, in the event of the normal supply failing whilst the sub-station is in operation, the machines are automatically shut down and restarted immediately the supply has been established on the other line, the interruption on the direct-current side being as brief as possible.

The sub-station is automatically controlled in accordance with the demand for load. When the voltage at a central point on the direct-current network, to which pilot-wires are connected, falls to a predetermined value, one of the machines starts up, and when this machine is working at approximately full load, the second rotary is automatically put into operation. When the load falls to a predetermined value, the sub-station is shut down in a similar manner, the voltage and current relays being adjustable in each case to suit requirements. Adjustable time lags are also provided to insure that temporary fluctuations in the load do not affect the operation of the plant.

In the event of the machines being required to start in advance of an anticipated load, or the station having to be shut down in the case of emergency, alternative control can be effected by means of pilot wires from another station, and, if desired, the equipment can also be manually operated, the automatic protective gear remaining operative in every case.

A special feature of the equipment is the provision of sequence control. Either set can be selected to be the first to be put into commission, the order of starting being determined by means of a multi-pole change-over switch, and if the machine first selected should be locked out owing

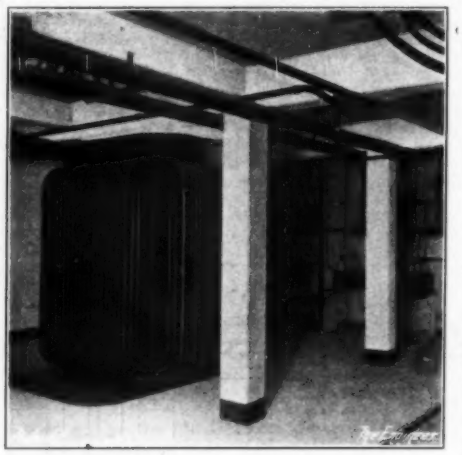


FIG. 4—TRANSFORMER IN BASEMENT

to a fault, the other machine will start instead. As the sub-station suupplies current to lighting networks, close voltage regulation had to be arranged for, and a voltage regulating relay is therefore connected to the same point in the network as the low voltage relay and controls, and by means of auxiliary contactors the field rheostats of the two machines are controlled. In this way very satisfactory regulation has been obtained, the voltage in the sub-station being maintained between the narrow limits of 446 and 454, corresponding to a mean pressure of 430 volts at the centre point of the system.

Books of Reference.

"THE Port of Hull Annual"—which is issued at the office of the "Port of Hull Monthly Journal," Bishop-lane, Hull, and is published at the price of 3s. 6d. net, can be recommended to all who desire to obtain information concerning the commercial development of the Humberside ports. The 1927 edition of the annual opens with an illustrated historical account of the rise and development of shipping on the Humber. This article is followed by one on the Yorkshire and North Midland Coalfield, after which accounts of the 1926 Hull coal trade and the coal supplies to and shipments from the port are given. The present dock accommodation is described and illustrated, as are also the inland water transport connections at the port, these accounts being followed by reviews of the shipping and shipbuilding positions. Thereafter follows a series of short illustrated reviews of the timber, trade, vegetables, oil industry, the grain provision, and oil, paint and varnish trades, and the fish and fruit trades. Then come classified lists of goods imported into and exported from the port of Hull, which are supplemented by similar information concerning the Humber ports of Grimsby, Immingham and Goole. The annual closes with a review of the Hull markets in 1926 and prices current.

"THE Empire Municipal Directory and Year Book, 1927–1928." Published by the Sanitary Publishing Company, Ltd., 8, Breams-buildings, London, E.C. 4. Price 10s. 6d. net, post free 11s.—This Directory is, in its present issue, in its forty-fifth year of publication, and the new volume appears to be even more useful than its predecessors. In a foreword written by Sir Henry Maybury it is stated that the book is looked upon as a standard work of reference at the Ministry of Transport, and that is hardly to be wondered at, for it contains between its two covers a large amount of information of a character that is not to be found, as far as we are aware, in any other single book. In addition to the directory proper, the character of which is now too well known to need any explanation from us, there are specially written articles reviewing the progress made in municipal engineering and kindred subjects during the past twelve months, as well as records of the present practice in such matters as "Roads and Road Making;" "Public Street Lighting;" "Motor Vehicles for Municipal Services;" "Water Purification and Softening;" "Sewerage and Sewage Disposal;" "Concrete and Concrete Construction;" "Fire Protection Services;" "Public Cleansing and Refuse Destruction;" and a number of other subjects. Then, too, there are particulars of municipal engineering, public health and scientific societies and of various official bodies, as well as a buyers' guide. In short, it is an extremely valuable book of reference.

"THE Directory of Contractors and Public Works Annual, 1927." Edited and compiled by C. W. Biggar. Published by Wightman and Co., Ltd., 104, Regency-street, Westminster, S.W. 1. Price 17s. 6d.—In this volume are given, first of all, lists of contractors for (*a*) railways, docks, harbours, piers and bridges; (*b*) waterworks; (*c*) gasworks; (*d*) tramways; (*e*) reinforced concrete; (*f*) roads and drainage; and (*g*) buildings. Then there are lists of architects; waterworks engineers; gasworks engineers, managers and consultants; and sanitary engineers. Then follow particulars of the Port of London Authority; the Thames Conservancy; the Metropolitan Water Board; the Corporation of the City of London; the London County Council; the Ministry of Transport; and H.M. Office of Works. Then there are lists of County Surveyors; Town Clerks; City and Borough Surveyors; Urban District Council Surveyors; Rural District Councils; London District Surveyors; and Local Authorities in the Irish Free State. Then there is information concerning the Admiralty and the Post Office Department. Lists are then given of railway engineers — official; locomotive superintendents and mechanical engineers; carriage and wagon superintendents and engineers; railway store-keepers; consulting civil engineers; dock and harbour engineers; tramway engineers and managers; merchants and exporters of contractors' railway and municipal plant and material; commercial and industrial engineers; and county engineers and surveyors in Scotland. Finally, there is a list of public works under construction and a contractors' plant and material buyers' guide.

"SPECIFICATION for Architects, Surveyors, Civil Engineers and for all Interested in Building." Edited by Frederick Chatterton. Published by the Architectural Press, 9, Queen's-gate, Westminster, S.W. 1. Price 10s. 6d. net.—In the 1927 edition of this book of reference, now in its twenty-ninth year of issue, there are several novel features. For instance, there is additional information regarding heating, window sash chains, door springs, &c., while such modern developments as white lines on highways, copper tubing for water services and the new glass that transmits ultra-violet rays, are dealt with. Mr. Walter R. Jaggard has contributed further double-page drawings to his series of "Standard Constructional Details," and there is, too, a plate illustrating various applications of plywood. In addition, in this year's issue there are six special articles, instead of the usual five. They are:—"The Planning of Nursing Homes," by Mr. C. H. Biddulph-Pinchard; "The Design and Construction of Games Courts," by "A Specialist"; "The Building Line in London and its Restrictions," by Mr.

Gilbert H. Lovegrove; "Escalators," by Mr. William Harvey; "Stainless Iron and Steel in Building Work," by "A Specialist"; and "The Treatment of Damp Walls," by Mr. Ernest G. Blake. The coloured plates are, as usual, excellent, a new one this year representing different kinds of bricks.

"THE Electrician Annual Tables of Electricity Undertakings, 1927." London: Ernest Benn, Ltd. Price 10s. net.—The new edition of this useful book of tables has been revised up to the last possible moment, and it contains details of several new undertakings, with particulars of projected schemes, &c. For the first time a comprehensive index covering the British tables has been included, and not only are the undertakings set out in alphabetical order, but those towns and even parishes receiving a supply in bulk are included. As regards the Colonial and foreign sections, apparently there is still difficulty in obtaining and verifying the data, but as far as possible the tables in these sections have been brought up to date. Altogether particulars of upwards of 800 British and 1300 Colonial and foreign undertakings are dealt with.

"THE Railway Year Book for 1927." Published by the Railway Publishing Company, Ltd., 33, Tothill-street, Westminster, S.W. 1. Price 5s. net.—This most useful book of reference now appears in its thirtieth annual issue, and manifestly needs no introduction from us. The present edition contains all the usual features, revised and brought up to date. Among the special features we notice an article dealing with the London, Midland and Scottish Railway covering the progress of reorganisation up to date. There are also new tables showing the steamship fleets owned and operated by, or in conjunction with, the Southern Railway. The present position of that company with regard to electrification is also discussed. In the Colonial Section, too, the changes brought about by the taking over of certain systems by the Indian Government are reviewed. There are also new maps of the Southern, Midland and Great Northern Joint, "Underground," Great Northern of Ireland, African and South American railways, while those of the Metropolitan Railway and of Australia have been corrected and altered to bring them up to date.

"STANDARDS Yearbook, 1927." Compiled by the National Bureau of Standards, being Miscellaneous Publication No. 77 of the United States Bureau of Standards. Washington, D.C.: The Superintendent of Documents, Government Printing Office. Price 1 dollar.—This is a newcomer into the ranks of books of reference. To give an idea of its scope we cannot do better than quote from a letter of submittal, which constitutes its introduction:—"The Standards Yearbook represents an effort to present an adequate picture of the diversification and ramification of the standardization movement, which has spread throughout the world with astonishing vitality during the twenty-five years that have elapsed since the establishment of the National Bureau of Standards. It contains outlines of the activities and accomplishments of not only this Bureau and other agencies of the Federal Government and the States and municipalities, but also of the American societies and associations, of which standardization is a major or very important activity. . . . Moreover, outlines are given of various foreign, national, and the several international standardizing agencies. . . . In this volume are correlated the essentials concerning standardization activities with which the Bureau of Standards is in close co-operation, and the subject of standardization is presented in its entirety."

South African Engineering Notes.

Largest Winding Hoist.

The winding hoist of the No. 15 shaft of the Crown Mines is thought to be the largest in the world. It is certainly the largest on the Witwatersrand at present, though it is believed that the City Deep, Ltd., will probably erect a larger one. The Crown Mines hoist is operated on the Ward Leonard system. The electrical plant comprises a generator set and two hoist motors. The generating set is made up of an alternating-current motor, two direct-current generators, and an exciter. The alternating current motor is a 2130 horse-power three-phase machine, and it is supplied with current at 2000 volts from a Victoria Falls power supply. It is direct-coupled to the two generators and to the exciter, and it runs at a speed of 485 revolutions per minute. The two generators have each a normal output of 950 kilowatts, with a maximum voltage of 500. The fields of the two generators are separately excited, the excitation being controlled by the Ward Leonard controller, worked from the driver's lever. The hoist motors are separately excited from the exciter on the generator set. The winding drums on this hoist are of the spiral type, the small diameter being 15ft. and the big diameter 30ft. The rope used for hoisting is a "non-spin," and is 2in. in diameter. This particular hoist hauls from a depth of 3175ft., and has a double deck cage running on steel guy ropes, each deck being capable of holding fifty men.

New Tram Design.

Two new trams are under construction in the Durban Tramway sheds, and will probably be put into service in June. They have been designed by Mr. H. W. Thomas, the tramway manager, and embody several novelties. The old outside staircase disappears, and in its place will be a short straight stair going up inside the body of the car. Two inside seats have been sacrificed to make room for this stair, but they are compensated for by increased seating capacity on top.

Sabie Hydro-electric Scheme.

The mines in the Sabie District (Transvaal) which have for a considerable time past been seriously handicapped by lack of power, will be materially assisted by the completion of the scheme which the Electricity Supply Commission expected would be ready for commercial service at the end of March. The undertaking consists of two hydro-electric power stations, one on the Sabie River and the other on the Malieveld Spruit, together with the necessary transmission and distribution lines. The installed capacity of the Sabie River Station is 1350 kilowatts, made up of three generating sets of 450 kilowatts each, while at the Malieveld Station one 350-kilowatt generator set has been installed. Intended to be a small stop-gap the Malieveld scheme was started upon December 1st, 1925. It will continue in operation until the main station on the Sabie River is completed, and it will afterwards, so far as necessary, be used as a standby and supplementary plant. The transmission line of the Sabie River scheme was completed by March, and work on the power station, &c., was well advanced by the middle of that month. The turbine installation consists of three wheels, each taking 35 cusecs normally and 45 cusecs on overload. Each wheel is direct-connected to a 600 kilovolt-ampère generator. Two of the units will be in service normally, the third being a standby. A weir about 10ft. in height has been erected on the Sabie River at a point approximately 9000ft. upstream from the power station. The water for working the turbines will be conveyed by means of a channel about 6500ft. in length from the intake at the weir to the forebay above the power station. The channel crosses an aqueduct and passes through three tunnels. The forebay is connected to the power-house by a 42in. pipe about 540ft. in length; the net operating head being approximately 200ft. Three-phase alternating-current at a pressure of 3300 volts and a frequency of 50 cycles will be generated. The pressure will be stepped up to 22,000 volts for transmission by overhead line to a sub-station situated about a mile from Sabie township, where it will be stepped down to 3300 volts for distribution to consumers. As part of the Sabie undertaking, the Commission has constructed a 3300-volt distribution line about three miles in length, over which power is conveyed from the Sabie sub-station to consumers in the Golden Valley area.

SIXTY YEARS AGO.

SIXTY years ago railway amalgamations were being keenly discussed in this country. In the United States it had been proved that long lines could be operated more economically and efficiently than a number of short sections, and in pursuance of the idea a number of amalgamations had been effected. In this country the leading railways were all the products of numerous amalgamations, purchases, perpetual leases, or other arrangements. Proposals were afoot, however, for carrying the process still further. The fusion of the London, Brighton and South Coast Railway with the South-Eastern Railway was being debated by the shareholders, but although a meeting was held, definite steps towards the proposed end do not appear to have been initiated. It was otherwise in the case of the proposed amalgamation between the Midland Railway and the Glasgow and South-Western Railway. That scheme, according to our issue of May 24th, 1867, had reached the stage of being submitted to Parliament in the form of a private Bill. The Midland at that date had a capital of £35,000,000, and owned about 900 miles of line. The Glasgow and South-Western had a capital of £8,000,000 and owned about 270 miles of line. For some years previously there had been a struggle for territory between the Glasgow and South-Western and the Caledonian railway companies. Pressed in every direction by its rival, the Glasgow and South-Western in 1864 sought relief by proposing an amalgamation with the Caledonian. The negotiations were broken off, and repeatedly resumed, until the Midland Railway in 1866 interposed and suggested that the Glasgow and South-Western should amalgamate with it. The object of the Midland in suggesting the amalgamation was to obviate the objection which it foresaw in the amalgamation of the two Scottish companies. It feared that if that scheme were carried through it would leave but one instead of two routes of access to the Glasgow area, and that that route would be dominated by the London and North-Western Railway, which line was already co-operating closely with the Caledonian in the handling of Scottish traffic. The scheme was warmly supported by civic, commercial and popular opinion in the towns and counties served by the Glasgow and South-Western Railway, but was opposed by the North British, the Caledonian, the Solway Junction, and the London and North-Western railways. It is difficult, without considerable research, to discover the exact fate of the Bill. It reached the report stage. Presumably it got no further. The proposed amalgamation, like that between the South-Eastern and the London and Brighton lines, did not take place. Both these schemes had to await fulfilment until January 1st, 1923.

MIDLAND BUILDING TRADES EXHIBITION.

OWING to the success of the Midland Building Trades Exhibition of 1925 it has been decided to repeat it, with many new features, this year. It will be held at Bingley Hall, Birmingham, from September 5th to September 17th next. The Birmingham Chamber of Commerce is again the organising body, and the Council of the Exhibition has undertaken the provision of stands on hire, fitted and erected. About 75 per cent. of the stand space has, we are informed, already been allotted.

Conferences will be held on the most recent developments in the building and allied trades, and discussions will also take place on lighting, cooking, heating, electricity services, hot water provision and kindred subjects.

The Lord Mayor of Birmingham—Alderman A. H. James, J.P.—is the President, and many architectural, engineering, builders', sanitary, civic engineers' and other associations and institutions have allied themselves with the Exhibition. There will also be a Public Works and Roadmaking section.

Further particulars may be obtained from the general manager, Birmingham and Midland Building and Allied Trades Exhibition, the Chamber of Commerce, Birmingham.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE MAGNETISATION OF DEXTRORSAL AND SINISTRORSAL HELICES.

SIR,—Text-books consulted do not explain why an electric current flowing (*a*) clockwise and (*b*) counter-clockwise in (*a*) a right-handed helix and in (*b*) a left-handed one respectively, should cause the end of an inserted iron core at the point where the current enters to become the south pole in the first instance and the north pole in the second, the opposite pole in each instance being at the end of the iron core where the current emerges. *Prima facie*, it appears, the electric current may occasion centrifugal force, which affects the stability of the aggregation of the electric particles or electrons and protons, or, in other words, vary the condensation of the electrons about the protons, causing the whirling corpuscles to group themselves into another configuration and to remain stable so long as the centrifugal force continues.

Is there any influence exerted by the earth—a huge metallic ball and magnet—by its counter-clockwise solar orbit and its counter-clockwise rotation. Would the earth's magnetic poles be reversed if its movements were contrary? It would be interesting to endeavour to ascertain whether more electric current is required for magnetisation when windings are clockwise than counter-clockwise.

I shall be glad to learn if there be any book respecting such theories.

FREDK. WM. ALEXANDER.

Teddington, May 23rd.

[Various speculations have been made as to the origin of magnetism in metals and several theories, such as Ewing's, have been propounded in which the electrons are made to play a prominent part in the causation of the phenomenon. Difficulty, however, is introduced by the fact that whereas all the elements contain electrons and should therefore be possible sources of magnetism, only three—iron, nickel and cobalt—are actually magnetic at ordinary temperatures and under normal conditions. —ED. THE E.]

BOOKS RECEIVED.

Die Trockentechnik. By Dipl.-Ing. M. Hirsch. Berlin: Julius Springer, 23, Linkstrasse, W. 9, Germany. Price, 31·80 marks.

The Railway Year Book, 1927. London: The Railway Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 5s. net.

Jahrbuch der Brennkrafttechnischen Gesellschaft E.V. Seventh volume. 1926. Halle (Salle): Wilhelm Knapp. Price 4.80 marks.

Proceedings of the Cleveland Institution of Engineers. Middlesbrough: The Cleveland Institution of Engineers, Corporation-road.

Mechanische Schwingungen und ihre Messung. By Dr.-Ing. J. Geiger. Berlin: Julius Springer, Linkstrasse 23, W. 9. Price 24 marks.

Spectroscopy. Vol. I. Third edition. By E. C. C. Baly. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 18s. net.

Hydro-electric Handbook. By W. P. Creager and J. D. Justin. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 40s. net.

Annales des Travaux Publics de Belgique. Tome XXVIII., 2me Fascicule. Avril, 1927. Brussels: Goemare, Rue de la Limite, 21.

Standards Year Book, 1927. Compiled by the Bureau of Standards. Washington: National Bureau of Standards, U.S.A. Price 1 dollar net.

Bulletin of the British Cast Iron Research Association. No. 16. Birmingham: The British Cast Iron Research Association, 24, St. Paul's-square.

Twenty-sixth Financial and Economic Annual of Japan, 1926. Tokyo: The Choyokwai, care of Government Printing Office, Japan. Price yen 2·00 net.

Lubrication and Lubricants. Fifth edition. By L. Archbutt and R. M. Deeley. London: Charles Griffin and Co., Ltd., 42, Drury-lane, W.C. 2. Price 30s. net.

Proceedings of the Chemical Engineering Group. Vols 6B and 7. London: The Chemical Engineering Group, Abbey House, Victoria-street, S.W. 1. Price 10s. 6d. net.

The Primary Decomposition of Coal: I., The Temperature of Initial Decomposition. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 9d. net.

Building Construction and Drawing. Part I. Tenth edition. By C. F. Mitchell. Revised by G. A. Mitchell. London: B. T. Batsford, Ltd., 94, High Holborn, W.C. 1. Price 6s. 6d. net.

Proceedings of the American Society of Civil Engineers. Part I., May, 1927. New York: The American Society of Civil Engineers, 33, West Thirty-ninth-street, U.S.A. Price 1·00 dollar net.

Report on the Industrial, Commercial and Financial Situation in Poland. By R. E. Kimens. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 1s. 6d. net.

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SUBMERSIBLE PUMPS, MERSEY TUNNEL WORKS

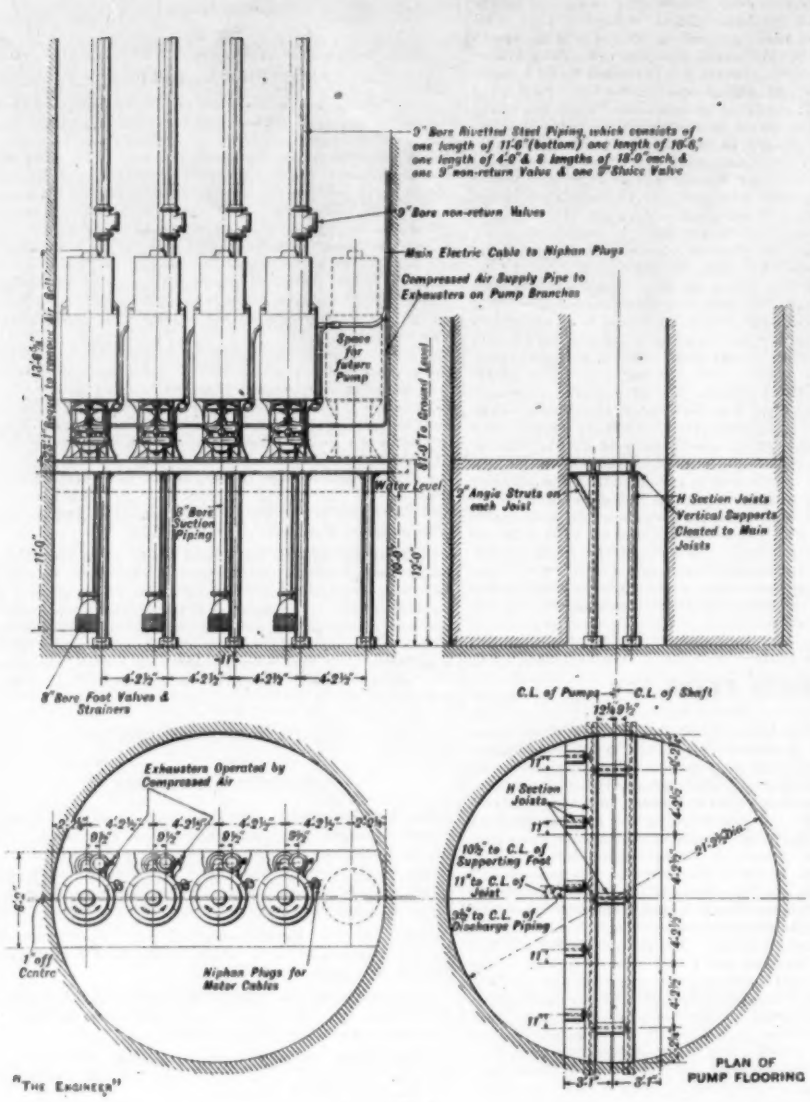

9" Bore Riveted Steel Piping, which consists of one length of 11-6" (bottom) one length of 10-6", one length of 4-0" & 8 lengths of 18-0" each, & one 9" non-return Valve & one 9" Sluice Valve
9" Bore non-return Valves
Main Electric Cable to Niphan Plugs
Compressed Air Supply Pipe to Exhausters on Pump Branches
Space for future Pump
9" Bore Suction Piping
2" Angle Struts on each Joist
H Section Joists Vertical Supports Cleated to Main Joists
8" Bore Foot Valves & Strainers
C.L. of Pumps
C.L. of Shaft
Exhausters Operated by Compressed Air
1" off Centre
Niphan Plugs for Motor Cables
H Section Joists
PLAN OF PUMP FLOORING
"THE ENGINEER"

FIG. 1

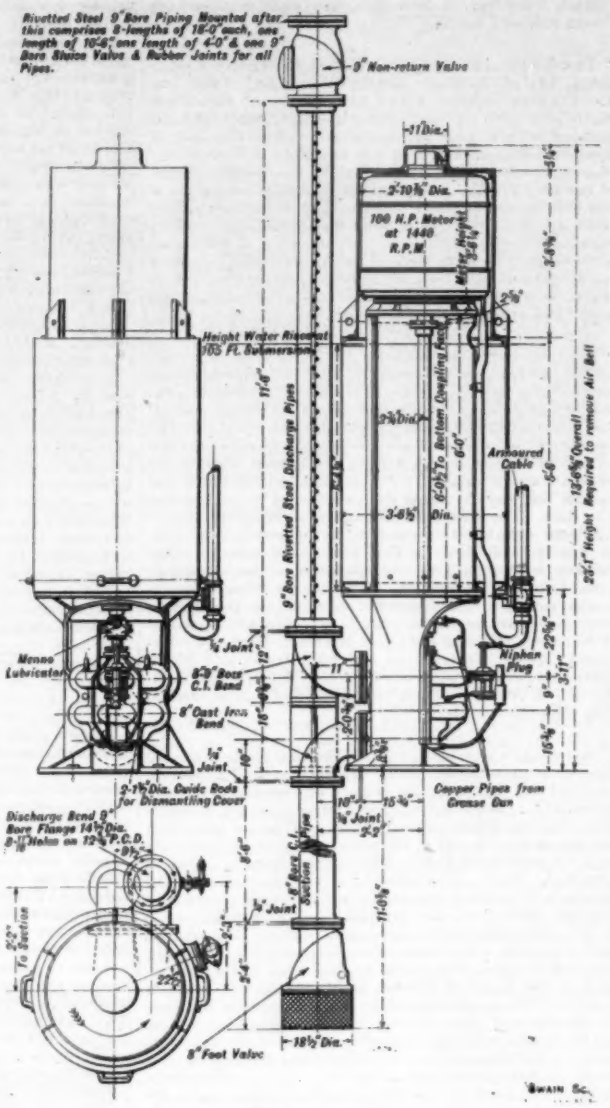

Riveted Steel 9" Bore Piping Mounted after this comprises 8-lengths of 18-0" each, one length of 10-6", one length of 4-0" & one 9" Bore Sluice Valve & Rubber Joints for all Pipes.
9" Non-return Valve
100 H.P. Motor at 1440 R.P.M.
Height Water Rises at 165 Ft. Submersion
9" Bore Riveted Steel Discharge Pipes
Armoured Cable
Nipple Plug
Copper Pipes from Grease Gun
8" Cast Iron Bend
2-1½" Dia. Guide Rods for Dismantling Cover
8" Foot Valve
BWAIN Sc.

FIG. 2

Submersible Pumps for the Mersey Tunnel Works.

In order to remove any water which may find its way into the subterranean works during the process of excavating the Mersey Tunnel, the contractors, Edmund Nuttall Sons and Co., Ltd., Trafford Park, Manchester, have installed at a depth of 170ft. below the ground level five electrically operated vertical two-stage centrifugal pumps, each of which is designed to deal with 1000 gallons of water per minute. The general arrangement of the plant is shown in the drawing, Fig. 1, from which it will be seen that the pumps are mounted on rolled joists supported across the downtake shaft at a height of 12ft. from the bottom. The pumps, which have been supplied by Drysdale and Co., Ltd., Yoker, Glasgow, are of that firm's two-stage pattern, having cast iron casings, hard phosphor bronze impellers, stainless steel spindles and external bearings. They are designed to pump against a total head of 210ft.

Particular care has been taken with regard to the lubrication of the bearings of these pumps, and a pneumatic grease gun of special design is provided for lubricating all the bearings from a central point. This arrangement is shown in the drawing, Fig. 2. Another feature of significance in connection with these pumps is their great accessibility, which is the result of making the front portion of the pump casing removable at the coupling, so as to give access to the whole of the internal parts for overhauling and examination without disturbing the shafting, piping or other fixtures. The pumps have to deal with a mixture of sand and water, and great care had to be exercised to ensure that the running parts were made of the hardest possible material while being easy of adjustment, so as to make the revolving parts as free as possible from vibration, They were, so we are informed, balanced on a special dynamic balancing machine at the makers' works.

Possibly the most striking feature of the plant is the method adopted to prevent access of water to the electric motor. With this object the motor is enclosed in an air bell—as seen in Fig. 3—which is designed to withstand internal air pressure to a head equivalent to the maximum flooding level which could occur in the tunnel.

The motors were built by Electromotors, Ltd., of Manchester, and are of the squirrel cage pattern. The output is 100 H.P., 1440 r.p.m., on a three-phase, 50-cycle, 400-volt supply. The machines had to be of special design to meet the somewhat unusual conditions with regard to duty and situation, for, under the actual working conditions, the pumps are started against the full head of water. A squirrel cage motor of normal design at the required output and speed has a starting current which would have been too heavy to allow of operation from the average public supply, and the motors had, accordingly, to be designed to start with a current demand of less than 1½ times full-load ampèrage. Then, in order to work in the restricted space under the air bell, a low temperature

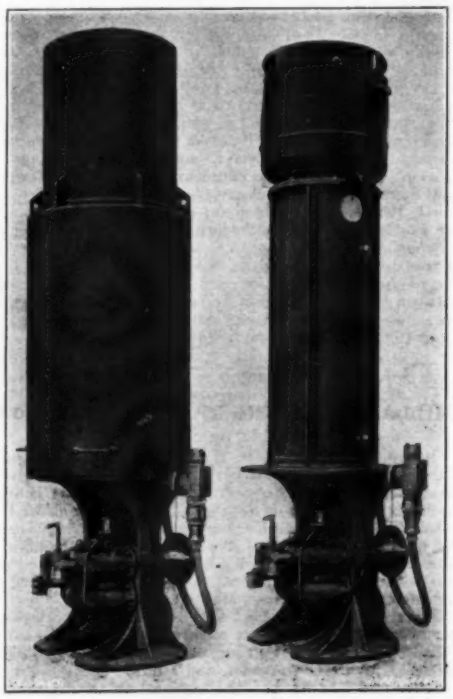


FIG. 3—PUMPS AND MOTORS

rise was essential, and the internal losses in the motor had to be kept down to the minimum. The tested efficiency on full load was, we understand, 89·5 per cent., with a power factor of 94 per cent. Moreover, since the atmosphere at the bottom of the shaft is very heavily charged with salt, the insulation and impregnation of the motor windings had to be carefully carried out.

It will be observed from the illustrations that the motor is supported above the trunk on a very light structure. The control gear is arranged at the top of the shaft, and is under the charge of the pump attendant.

INTERNATIONAL COMMISSION ON ILLUMINATION.—The International Commission on Illumination is holding a short session at Bellagio, from August 31st to September 3rd. A plenary session of the Commission should take place in New York this year, but for various reasons it has had to be postponed until 1928. The session at Bellagio is solely one for the executive committee and the various sub-committees appointed by the Commission to study such problems as factory and school lighting, automobile headlights, heterochromatic photometry, definitions and nomenclature and colorimetry. The meeting at Bellagio will be under the Presidency of Dr. E. P. Hyde, and the arrangements for the meeting are being carried out by the Italian National Committee on Illumination.

CARDINGTON AIRSHIP TOWER.—In the article on the airship mooring tower at Cardington, which appeared in our issue of March 11th, we illustrated in Fig. 10 the cup and cone arrangement at the end of the telescopic arm and called particular attention to the large ball bearing containing thirty-two 2½in. diameter balls on which the cup is mounted to rotate. We have since learned that that bearing was made by the Ransome and Marles Bearing Company, Ltd., of Newark-on-Trent. The bearing is of the "double purpose" type and is specially designed to withstand combined journal and thrust loads. The races are packed with balls, the movement being sufficiently slow to eliminate any detrimental effect arising from the absence of a cage. Similar bearings fitted with cages have, the makers inform us, been successfully fitted by them in instances in which the speed has varied from a few hundreds to thousands of revolutions per minute and in which the load has been either a pure thrust or a combined journal and thrust load.

THE INSTITUTION OF ELECTRICAL ENGINEERS: WIRELESS SECTION COMMITTEE, 1927–28.—The following have been nominated by the Wireless Section Committee to serve on the Committee from October 1st, 1927:—Chairman, Lieut.-Colonel A. G. Lee; ordinary members, Mr. J. Hollingworth, Mr. E. B. Moullin, Mr. G. H. Nash, and Mr. C. E. Rickard. Not later than fourteen days after the publication of the Committee's list of nominations, any five members of the Wireless Section may nominate any other duly qualified person to fill any vacancy by delivering such nomination in writing to the secretary of the Institution, together with the written consent of such person to accept office if elected, but each such nominator shall be debarred from nominating any other person for the same election. The following will continue to serve as members of the Committee:—The President, the Chairman of the Papers Committee, a nominee of the Council, a nominee of the General Purposes Committee, Major B. Binyon, P. R. Coursey, Captain P. P. Eckersley, Dr. R. V. Hansford, Professor E. Mallett, S. R. Mullard, E. H. Shaughnessy, and G. Shearing, together with one representative each to be nominated by:—The Admiralty, the Air Ministry, the General Post Office, and the War Office.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

In spite of the recent reduction in the raw iron and structural steel prices, anything in the nature of a buying movement has not yet made itself evident. A week ago there were industrialists in the Midlands who considered the easier price conditions would prove effective in stimulating demand. The tentative symptoms of a week ago, however, were not substantiated. Having satisfied immediate, and in some cases early requirements, at the lower prices, buyers again abstained from buying, contending that the reductions are insufficient. Iron and steel masters hold that any easing of production costs has been more than counterbalanced by recent price reductions, and though they are badly off for business, they cannot see their way to accept lower terms, if they are to employ their resources profitably. Midland smelters do not see the reasonableness of following the course adopted by Cleveland pig iron producers. They speak of curtailing production if demand does not improve, intimating that they consider it a wiser course than producing at a loss, as Cleveland smelters are stated to be doing. Iron and steel values, nevertheless, show weakness, and on 'Change in Birmingham to-day buyers claimed that sellers were prepared in many instances to shade the recognised quotations to secure orders. Forward buying is still avoided, little confidence being felt in present prices as a basis for enterprise. Business is backward, and negotiations which are opened materialise only slowly.

Raw Iron Values.

The Midland pig iron position is considerably easier, though buying continues on a small scale, consumers awaiting a more favourable opportunity to place forward contracts. Smelters in this area are now in a more encouraging position with regard to coke. The high cost of blast-furnace fuel has been one of the chief obstacles to the lowering of pig iron prices. Now that the coke ovens have been forced to give way, and fuel is obtainable at from 5s. to 6s. per ton below the basis fixed for this quarter of 22s. per ton, pig iron producers find themselves able to some extent to meet the persistent calls for lower iron prices. Reductions varying from 2s. 6d. to 5s. per ton have been made by Derbyshire and Northamptonshire smelters, who are anxious to encourage any nascent demand there may be. On 'Change in Birmingham this week more furnacemen were ready to book Northamptonshire No. 3 foundry at £3 12s. 6d., and £3 17s. 6d. was a fairly common price for Derbyshire No. 3. North Staffordshire iron was down to about £3 18s. It is generally considered that prices will have to fall still further before a real buying movement sets in.

Blast-furnace Fuel.

Blast-furnace coke values continue to fall, and business has been done this week on the basis of 16s. per ton at ovens. The scales have now turned in favour of the purchaser, and on 'Change to-day consumers were stated to be pressing for even lower rates. It was reported that at least one ovenman had shaded the 16s. quotation, and others were expected to follow suit. Smelters have already reduced pig iron prices, and they are anxious to get as large concessions as possible from the coke suppliers, who have, they claim, treated them so hardly of late.

Steel Prices.

The weakness in steel values, referred to in my last letter, has been followed, as was anticipated, by a reduction in selling rates. Values of angles and joists have fallen half-a-crown per ton, being now offered at £7 12s. 6d., which was the basis last declared by the Association. This has never been formally superseded, but sellers have been getting such premiums as the abnormal conditions of the market allowed. Though actually only having reverted to the declared basis, steelmasters have cut their quotations by half-a-crown. No change has been made in ship, bridge and tank plates, which were already back at basis. While £11 10s. is the Association rate for boiler plates, business has for some time past been done at less. As low a figure as £11 is not unheard of. Scrap is weak at £3 2s. 6d., delivered South Wales. Hinge strip, which has stood at £10 in this market, has now been freed from price control. A considerable amount of semis and finished products continues to come into the district from the Continent, principally from Belgium. Quotations have an upward tendency this week. For imported billets £5 10s. was asked yesterday, as against native makers' figures of £6 15s. to £7; 6in. blooms were quoted £5 3s., and sheet bars £5 12s. 6d. A good deal of work is in hand at the steel works, though new business is coming in but slowly.

Manufactured Iron.

The Staffordshire bar iron industry remains dull, and those ironmasters who have turned their attention to the re-rolling of steel and who have been kept fairly busy up to now, are beginning to feel the lack of demand. In this department, indeed, business has gone decidedly slack. The decline in purchases of continental raw materials in recent months is attributed partly to the fact that re-rollers are unable to convert the foreign half-products into the finished article through the failure of demand. There are large accumulations of continental semis in the Black Country, where mills are standing for lack of orders. Makers of marked bars continue to find a market for their output at £14 10s., but producers of Crown bars are unable to effect sales, even though they have in many cases reduced their quotations by 5s. per ton. Nut and bolt and fencing bars find few purchasers, the £10 5s. quotation of local makers comparing very unfavourably with that of Belgian houses which offer supplies at about £6 2s. 6d., delivered Darlaston. This is 2s. 6d. above last week's minimum, but sellers do not fear competition from Staffordshire makers.

Galvanised Sheets.

Local galvanised sheet mills are fairly occupied, quite a good amount of new business having been received from overseas. Home demand is on the quiet side, but the calls upon the mills are such that values are easily upheld. Galvanised corrugated sheets of 24 gauge command £14 15s. to £15, and more sellers quote the latter figure than the former, though for substantial business, most, if not all, of them would be prepared to accept £14 15s. Prices of thinner gauge sheets are likewise firm.

Cheaper Power.

Birmingham manufacturers utilising gas for motive power are pleased to hear that the City Gas Committee has decided upon a further decrease in charges. At a time like the present, when production costs weigh so heavily upon industry, a reduction of even 4d. per 1000 cubic feet of gas is a matter for congratulation. The Committee's decision follows upon the satisfactory result of the past year's trading, which was comparatively good, in spite of the prolonged coal stoppage. The new rates, which take effect as from the June reading of the meters, are :—Up to and including 1,000,000 cubic feet per quarter, 2s. 8d. per 1000 cubic feet; quantities in excess of 1,000,000 up to 2,000,000 cubic feet, 2s. 5d.; 2,000,000 up to 3,000,000, 2s. 2d.; 3,000,000 up to 4,000,000, 2s. 1d.; 4,000,000 upwards, 1s. 11d. These prices, moreover, are subject to a discount of 5 per cent. for prompt payment.

Engineering at Coventry.

There is little change in the engineering situation in Coventry, trade being fair, but by no means good. Motor engineering establishments find demand spasmodic, and while certain works are decidedly busy, others have difficulty in finding regular employment for their resources. The general position may be gathered from the fact that the machine tool trade, which is a very sensitive barometer of the state of the motor industry, reports that there is nothing of a striking nature to record as regards the home market. The fact that the local unemployment returns fail to show any steady reduction, and actually remain higher than they were two months ago, is not encouraging. Their fluctuation is indicative of the lack of stability under which the Coventry industries are still labouring.

General Engineering.

Midland engineers generally are far from satisfied with the present position of trading affairs. Many of them are becoming anxious as to the future. At the moment, certain sections of the trade are decidedly dull. Constructional engineers are fairly busy, but the work is chiefly concerned with small tonnages of material urgently wanted. Big business is being held back, it is thought, in the hope of better terms. Electrical engineers are receiving very few new orders, and order books are becoming thin. There is no decided improvement in the heavy edge tool industry, works being employed only irregularly.

Unemployment.

While the statistics relating to the conditions of employment in the Midlands showed last week the substantial decrease of 17,060 in the number of persons out of work as compared with the figures for the week previous, the most recent returns exhibit a slightly less favourable state of affairs. From 131,560 the number of men, boys, women and girls on the live register on May 9th, the total has risen to 139,825 for the week ended May 16th, an increase of 8265.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Lancashire and Russia.

DEVELOPMENTS in the Anglo-Russian situation have created much uneasiness in the Lancashire engineering trade, more particularly among textile machinists and machine-tool makers. Last year shipments of British textile machinery to Russia reached a total value of nearly a million and a-quarter pounds—the exact figure was £1,221,182—and with the exception of the British East Indies, Russia was the largest individual export market for that branch of engineering. As was pointed out in this column a week ago the huge contracts for textile machinery which Russia placed in this country in 1925 are virtually completed—the Board of Trade returns for last month clearly indicated this—but Lancashire manufacturers have been very hopeful of securing further substantial orders to follow them up. What effect recent political developments may have is not yet clear. Judging from a statement made this week by a prominent maker of textile plant it would appear that hope has not by any means been entirely lost. On the grounds that a diplomatic rupture need not necessarily mean a break in commercial relations, although it might entail delay in the placing of contracts, and that the results of trading during the past two years between Lancashire engineering firms and the Russian Textile Syndicate have been mutually satisfactory, he sees no reason why further contracts should not be placed and accepted providing the conditions were satisfactory. Reference to the position was made by Mr. J. Brownlie, President of the Amalgamated Engineering Union, in the course of his presidential address at the National Committee meeting at Blackpool on Tuesday of this week. He said that it would be a serious matter for the country, and for engineers in particular, if anything were done to impair the country's trade relationship with Russia.

One of the Railways.

Expedition in railway goods transport is the subject of a tribute paid by Mather and Platt, Ltd., engineers, of Manchester, this week. In a letter to the *Manchester Guardian* they give particulars of the delivery of a volume of traffic to a port in Scotland, where the London, Midland and Scottish Railway enabled the firm to effect delivery of a contract in remarkably quick time, and with the smallest cost for packing cases. The distance from Manchester to the destination station was 285 miles, and the consignment in each instance consisted of sixteen cases of machinery. The first consignment left Messrs. Mather and Platt's works on the Thursday, the packages were delivered to their clients, they were unpacked, and the empty packages were back at the works on the following Monday. They re-delivered the same cases to the railway company on the same day, and the empties were back again at the Manchester works on the following Thursday, leaving again for Scotland on the same day. The sixteen cases were thus on their third journey to Scotland on the eighth day. Messrs. Mather and Platt cite this as merely one instance out of many that could be given where really good delivery service has been carried out by co-operation between railway company and trader.

Non-ferrous Metals.

Whilst tin has recovered much of the ground lost in the previous week, and spelter, also, is rather firmer on balance, both copper and lead have further receded. In the case of tin price fluctuations have been very much in evidence, and at the close of the market last week end values had shown little improvement over the low prices quoted here a week ago. During the opening days of the current week, however, there has been a relatively substantial gain and a steadier feeling exists at the moment of writing. Whether it will last long remains to be seen. Buying has been on a limited scale, although continental and American interest has been more pronounced. In the copper section of the market buying has been subdued all round, and with the demand for the metal insufficient to absorb the quantities on offer the condition has been clearly reflected in prices, the tone at the moment being distinctly weak. A reduction in the offers of spelter rather than any spurt in the demand for it—for this has continued on quiet lines—has resulted in a somewhat steadier feeling. Lead has been subject to bearish influences during the week—poor buying interest, coupled with supplies which have been more than ample to meet current requirements—and quotations have finished up about 5s. lower in consequence.

Pig Iron.

The iron market here was taken by surprise last Friday by the sudden drop, for the second time within the last few weeks, in Middlesbrough iron, although buyers were expecting and sellers seemed resigned to a further weakening. The change was made too late, however, to have much practical effect on the market last week, and even this week it has had little influence from the point of view of stimulating buying. Here and there are reports of a slight improvement, but business is still largely of a day-to-day character, and contract buying is a rarity yet. As a matter of fact, the market is still under the disturbing influence of the fall, and users have hardly had time to make up their minds whether or not to take the plunge. Midland iron producers have had, perforce, to fall into line, and down to 75s. per ton on rails, at the blast-furnaces, has been quoted this week for Derbyshire brands, equal to a delivered price in Manchester of 83s., which compares with the 83s. 2d. at which Middlesbrough No. 3 is now offered for delivery into this area. Moreover, where the railway rate factor operates to the disadvantage of the Derbyshire maker, the 75s. furnace price is being shaded sufficiently to meet the Middlesbrough competition. Other brands of iron are also easy, Scottish makes being quoted down to 99s. per ton, delivered Manchester or equal, and hematites at about 93s. 6d. Finished iron is not in sufficient demand to keep Lancashire makers fully employed, buying remaining on a very moderate scale. There has been no change in prices, however, Lancashire Crown bars being quoted at £11 and second quality at £10 per ton.

Steel.

Steel sellers on this market are waiting patiently for the orders which users seem so very reluctant to place. A certain amount of buying is, of course, going on, but it is of relatively little consequence, and certainly much below the tonnage necessary to make good the contracts that the rolling mills are completing. For the most part, buyers are showing little interest in forward positions, in spite of the fact that premium prices over and above the official minima practically no longer exist. Probably the next step for which they are waiting is a reduction in the latter, for the feeling is that these cannot be maintained indefinitely. For a good order boiler plates have been offered this week at £11 5s. per ton, though current values range between that figure and £11 7s. 6d. Ship plates are on offer generally at £8 7s. 6d., and joists and sections at £7 12s. 6d., both for prompt and forward delivery, with bars quoted at £8 5s. to £8 15s. per ton. Galvanised sheets have kept fairly steady at £14 12s. 6d. per ton f.o.b., for the usual Indian specifications, and sellers continue to report a rather better volume of buying from that quarter. Imported steels are not selling in quantity, but continental makers have apparently reached the stage when they deem it advisable to cry halt so far as prices are concerned. These have been sagging steadily for some time now, and, in consequence of the firmer attitude of makers, offers have been on a somewhat higher level, although, in view of the poor business that is being done, they are more or less nominal. Sheet bars are at £5 7s. 6d. to £5 10s., billets at £5 2s. 6d. to £5 5s., steel bars at £5 17s. 6d. to £6, wire rods at £6 10s., sections at £6, Siemens plates at £7 7s. 6d., ordinary plates at £7, and bar iron at £5 15s., for cash against shipping documents, and including delivery to users' works in Lancashire.

Scrap.

A trifle more business has been reported in non-ferrous scrap on this market. Brass rod turnings are quoted

at £38 10s., selected gun-metal scrap at £51 10s., heavy yellow brass at £44 10s., zinc at £23 to £24, lead at £24 to £25, clean light copper at £56 10s., and cast aluminium at £78, for graded qualities, delivered to users' works.

BARROW-IN-FURNESS.

Hematites.

The activity in the hematite pig iron trade of this district is well maintained industrially. In all there are sixteen furnaces in blast, and a good volume of iron is being turned out. The deliveries are on contracts previously held, and the rate of production can be maintained for some time yet. The whole of the iron smelted is going into immediate use. Barrow and Workington steel makers are steady users. Pig iron had been shipped from Barrow Docks to Calcutta and also to Philadelphia, but new business is quiet, with no forward trade being offered at all. There is a fair demand for refined iron. No charcoal iron has been smelted for some time.

Iron Ore.

All through the iron ore raising areas there is a busy state of affairs. The demand is mostly local, but some best sorts are leaving the district. Foreign ores are being imported for mixing purposes.

Steel.

In the steel trade, both at Barrow and at Workington, there is still much activity. The chief output at present is that of steel rails for home and overseas users. Heavy tonnages of hoops are being rolled at Barrow for overseas. The foundries are also busy. Rails are quiet in demand, but hoops are a good steady trade.

Fuel.

For steam coal the demand is steady, and East Coast coke is in good demand with prices a shade easier.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Trades.

It is not as yet possible to report any change in the condition of the heavy trades of Sheffield and district, and the position is so full of uncertainty that managers are in something of a quandary. As to which way things are going to turn, whether for better or worse, it is impossible to say, but for the time being the steel makers are not making any drastic change in their policy. There has been no further curtailment of production, but it is a difficult proposition in these days to carry on with thin order books. At the same time there are several features of the market which give room for hope. The trouble in regard to the fixing up of new forward business in the iron and steel trades has been over prices, and with these at a higher level than for a long time past, it is only natural that buyers have refused to commit themselves. The scarcity and dearness of coking slack forced a high price for blast-furnace coke to be fixed recently, and though this price has not been changed officially, the position is weak, and I have heard of contracts being arranged at less than the figure agreed to originally. The coke market, in fact, is actually described as slumping. Anyhow, the price of Derbyshire and Lincolnshire foundry pig has come down from 80s. to 77s. 6d., and the influence is bound to be felt in the Sheffield district shortly. There are indications of a revival of buying in the pig iron market. In a period of high prices for raw materials, it is refreshing, from the point of view of the buyer, to hear of something in which big cuts are being made. This is the case with ferro-manganese, owing to the breakdown of the ring. For many years the British and American producers have maintained the price at £16 per ton, but Norwegian competition has developed recently, and in order to meet it the Association price has been reduced to £12 a ton. It is hardly necessary to add that steel makers are taking full advantage of this opportunity, and large contracts have been placed at the new figures.

Recent Heavy Steel Output.

Details have just been issued of the output of steel from the Sheffield district furnaces during March. The figures confirm the statements made at the time that considerably more steel was being produced than before the coal stoppage. During the month the district produced 135,000 tons of steel ingots. Of these, 58,600 tons were acid steel, 65,000 tons basic, and 11,000 tons of other descriptions of steel and steel castings. The total is nearly 30,000 tons more than in March last year.

Engineering Departments.

The engineering trades generally are quiet, though one hears occasionally of works that are pretty well booked up. In Sheffield, Leeds and other large centres one hears frequent complaints of the severity of foreign competition, particularly from Germany and other continental countries. The orders for locomotives and railway stock from abroad, which have been placed recently have proved extremely useful, and the electrical and motor car industries have also been most helpful with their substantial buying. Farm machinery for the Continent, which at one time was bought liberally in the engineering district of North Lincolnshire, is not now going away well, and for this fact again, foreign competition is blamed. At present there are numerous inquiries in the market for railway material for India.

Plate and Cutlery.

The plate and cutlery trades are still in the stagnant condition in which they have been practically ever since the end of the buying season last Christmas. There have been one or two spurts in trade, but they have come to nothing of a permanent nature in the end. The decreased purchasing power of the public following last year's industrial trouble is undoubtedly still having an adverse effect, for it is noticeable that there is an exceptionally quiet demand for all classes of silver and best-quality electro-plate ware that may be termed luxuries. In the ordinary stainless cutlery lines, too, there is a lower level of sales to the public. There is a moderate demand for the better quality scissors and pen and pocket knives, but in the cheaper lines the bulk of the patronage appears to be given to low-prices imported articles. In spite of the duty that was put on foreign cutlery under the Safeguarding of Industries Act, large quantities are still being imported into this country. The output of spoons and forks at the Sheffield works is comparatively poor. One of the few branches that can be said to be flourishing is that devoted to the production of safety razor and blades.

Grinding Dust Problem.

Under the Grinding Regulations which became operative on January 1st, 1926, the removal of dust in the grinding trades is compulsory, and experiments are continually proceeding with the object of improving the methods of effecting the removal. The problem is a particularly difficult one in the process which is known as stone racing. A racing-dust collecting plant, designed by Dallow, Lambert and Co., Ltd., engineers, of Leicester, in co-operation with Barker and England, Ltd., machine knife manufacturers, of Colver-road, Sheffield, is claimed to offer a handy solution of the problem of collecting at the point of production the great masses of dust formed during the racing of grindstones, and a demonstration has been carried out at the works of Barker and England before Mr. John Law, factory inspector, and representatives from the leading Sheffield firms interested in grinding processes. A stone, 6ft. by 11in., was raced for about two hours, and the result was favourably commented upon. The plant operates on the vacuum principle, sucking in the dust and re-passing only purified air. One of the main features that the designers have had in mind has been to make the apparatus sufficiently small and compact to be portable, and quickly fixed, thus permitting its removal from stone to stone. The plant consists of a high-power motor-driven fan, provided with a flexible connection to a hood over the back of the stone, which induces a keen draught through a specially constructed channel placed round the front of the stone at the point of racing. This channel is so arranged that the dust, instead of flying into the shop, is drawn downwards through the trough to the fan, which delivers it into a specially prepared filter forming part of the portable apparatus. Attached to the plant is a pneumatic cleaning apparatus, enabling the roof and walls of the shop to be cleaned by suction to meet the requirements of the Home Office. The fan has been designed so that without alteration a large volume of air can be handled at a low pressure for racing purposes, or a small volume at very high pressure for cleaning purposes.

Parkgate Iron and Steel Company.

In the annual report of the Parkgate Iron and Steel Company, Ltd., which incidentally indicates a loss of £32,789 during the year, it is stated that a complete battery of gas machines is being installed, which will effect a considerable saving in the cost of production. A new ingot soaking pit has been built. It has just been started, and will help to increase production.

Difficult Engineering Feat.

One of the most difficult engineering feats attempted by the engineers of the London, Midland and Scottish Railway Company has begun just outside Swinton Station on the main line between Sheffield and Leeds. Owing to subsidences, the company has found it necessary to raise its bridge near the Dover and Dearne Canal by 4½ft. Progress will be slow, owing to the number of trains passing over the bridge daily. The bridge was originally constructed to carry two sets of lines, and the stone arches in the centre are fitted with steel girders on either side, which were added when the line was widened over thirty years ago. The arches are to be replaced by girders. The actual lifting is only possible on Sundays, and on other days men are employed in preparing for the lift, which is done 10in. at a time. About thirty men are employed on week-days and nearly one hundred on Sundays. The work will be carried out without causing any appreciable delay in the train services.

New Derbyshire Industry.

It is announced that the well-known cement-making firm of G. and T. Earle, Ltd., of Hull, contemplates establishing a cement works in the Hope Valley in Derbyshire. Negotiations are in progress for the acquisition of land at Hope, Bradwell and Pin Dale, and, if successful, Messrs. Earle intend to establish their works adjoining the railway line about a quarter of a mile on the Sheffield side of Hope Station, and to have an aerial conveyer across the valley to the works.

NORTH OF ENGLAND.

(From our own Correspondent.)

Ironmasters Bold Step.

The Cleveland ironmasters are leaving no stone unturned in their efforts to restore the pig iron industry to something like its former prosperity. Another reduction of 5s. per ton has been made in prices, making 15s. per ton since the beginning of the year. The latest cut brings the price of the standard quality to 70s. per ton—a quotation which ruled before the coal strike of last year. The course of events in the pig iron trade since the beginning of 1927 has been very disappointing. Whilst the steel trade of the district has achieved record outputs and record exports, the pig iron trade has languished, and the ironmasters have been confronted with a situation which demanded a drastic remedy. Practically the whole of Cleveland's once vast export trade has been lost and, in addition, home markets have been invaded by cheap foreign iron to such an extent that even in Scotland—usually one of Cleveland's best markets—Cleveland iron has been virtually excluded. Under these circumstances an increasingly ominous situation has developed. Ironmasters have been producing more iron than they could sell, and they were faced with the alternatives of cutting prices in the hope of stimulating demand, or reducing output by stopping a number of furnaces. The first expedient is to be tried first, but if it fails the second is inevitable. The new prices are not yet competitive with those of continental makers, but the margin has been narrowed down considerably, and it is hoped that Scottish and other home foundrymen will revert now to the use of Cleveland iron though it may cost a little more than imported iron.

Cleveland Iron Market.

Since the further cut in prices of Cleveland pig iron was only made on Friday of last week, it is early yet accurately to assess the effect of the change, but at the time of writing business is still extremely slack. Many consumers have entered into heavy contracts for foreign iron, and it may be some little time before they need to come on to the market for further supplies. A few local sales have been put through, and there are one or two big inquiries, but some buyers are still seeking to "bear" the market, and are apparently endeavouring to test the possibilities of further reductions. Such reductions are very improbable. Makers point to the fact that they are already selling below cost, and rather than increase their losses they are likely to reduce production, if the latest cut does not stimulate the demand. However, it has not been demonstrated that that course will be necessary. The demand may improve, and in that hope makers are offering iron at the new rates, viz.:—No. 1 Cleveland foundry iron, 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. per ton.

Hematite Pig Iron.

The situation in the East Coast hematite pig iron trade is unsatisfactory. The very moderate requirements are insufficient to absorb output, and while the already limited production is to be curtailed by the damping down of three furnaces this week-end, supply promises to continue fully adequate to meet needs. Makers have rather considerable stocks, and the maintenance of already unremunerative market rates seems doubtful. The three furnaces to be damped down at the Ayresome Ironworks of Gjers, Mills and Co., Ltd., Middlesbrough, were put into operation at the beginning of January, after having been idle throughout the coal dispute. The number of blast-furnaces in operation on the North-East Coast will thus be reduced to 44, as compared with 38 before the coal strike. Mixed numbers of hematite are quoted at 79s. 6d. per ton, but probably a concession on this price might be obtained for a substantial order.

Ironmaking Materials.

With consumers now carrying considerable stocks, and having heavy contracts arranged, foreign ore is all but unsaleable, and market rates on the basis of best Rubio at 22s. per ton c.i.f. Tees, are nominal. Blast-furnace coke prices still tend downward, notwithstanding producers' complaint that quotations have sunk to unprofitable levels, and that a further fall may be followed by ovens going out of operation. Durham good medium sorts are 22s. to 22s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

In the manufactured iron and steel trade, production continues heavy, but sales are still very disappointing. Consumers of semi-finished steel are understood to have bought large quantities of continental material and are not disposed to commit themselves further at present. Local products are offered very freely. Some little improvement in inquiries for finished steel is reported, and buyers who are believed to have been holding back in the hope of lower prices may possibly be induced to place business now that the manufacturers have revealed their hand. The Association has decided to stabilise prices at the present levels at least until the next meeting in September, and as there have been some complaints of preferential rates to the foreigner, the minimum export prices, which are lower than home rates, have been raised 2s. 6d. per ton.

The Coal Trade.

Indications of returning activity in the Northern coal trade are difficult to discover. Both collieries and merchants report a very quiet state of affairs, and it is hard to say when any alteration for the better may be expected. Some fitters incline to the view that trade will pick up in the second half of the year. Others think consumers abroad are at length realising that prices are at rock bottom, and that such customers will come on the market for their requirements in the near future. There is on the surface very little to justify these hopes, for in many instances offers from this area are met with counter offers at lower figures, or there is intimation that coal on the continent is plentiful and cheaper. There are extremely few inquiries on the market. Producers are strenuously endeavouring to maintain present values, but it is not easy in the prevailing weak state of the demand. Best Northumberland steam coals are well booked for the next week or two, though in two or three instances fitters have a difficult task to keep the pits working. Best qualities are quoted up to 14s. 9d., but 14s. 6d. seems to be the accepted value, while seconds command 13s. 9d. Steam smalls are well sold in some instances, and plentiful in others. Prices range from 10s. to 11s. according to quality. Gas fuel is fairly well stemmed, but much more trade could be handled if it were forthcoming. Sellers find it difficult to maintain recent quotations, though nominally there are no changes. First grades are 17s. 6d., but there are good sorts on offer at 16s. 9d. to 17s. There are full offerings of coking coal at 14s. to 14s. 6d., and bunkers are also plentiful at 14s. 6d. to 16s. The coke market is steady for all makes. Gas coke is well booked, and in steady demand for shipment over the next few weeks, and 19s. 6d. to 20s. is firmly asked. There is a good demand for patent cokes at 21s. 6d. to 22s. 6d.

SCOTLAND.

(From our own Correspondent.)

Steel Prices.

As a result of the decision reached at last week's meeting of English and Scottish steel makers, no change will be made in official minimum prices of steel for home delivery, and consequently for delivery in the Clyde area prices are as follows:—Boiler plates, £11; ship plates, £8 2s. 6d.; sections, £7 12s. 6d. It was, however, agreed to raise prices of ship plates, sections and joists for export by 2s. 6d. per ton. Prices of these products for export are "free," but recently have been quoted as follows:—£7 10s. steel plates and £7 per ton sections. Boiler plates for export remain at £11 per ton f.o.b. Glasgow.

Shipbuilding and Other Contracts.

D. and W. Henderson and Co., Ltd., of Glasgow, has orders to build a cargo steamer of 8300 tons for Glasgow owners, and a cargo steamer of 290ft. length, 43ft. breadth, and 28ft. 3in. depth, for the British and Continental Steamship Company, Liverpool. The first-mentioned vessel is a duplicate of one already in course of construction at Messrs. Henderson's yard. Sir William Arrol and Co., Ltd., Glasgow, has received an order for the power station and boiler-house for the new Deptford West Power Station, of the London Power Company. The steel work is estimated at about 7500 tons. P. and W. MacLellan, Ltd., Glasgow, has secured the order for the new steel bridge to be erected over the river Jumna, near Allahabad, for the East Indian Railway.

Steel and Iron.

The outlook in the steel trade becomes more obscure. Business on hand is lessening rapidly, and manufacturers are not booking much in the way of fresh contracts. Foreign competition in home and export markets is very keen and home producers are not hopeful of booking much business in the immediate future at least. Makers of shipbuilding materials are busy on old contracts, but fresh contracts are slow to materialise, and buying is mostly of a hand-to-mouth description. Bar iron is in very quiet demand, and the re-rolling departments are similarly placed. The pig iron market is inactive. Hematite has only a very moderate demand, while foundry qualities are easily obtained. Prices of pig iron are easy, though showing no change on the week.

Steel Sheets.

The demand for sheets has been comparatively good during the past week or so, and a firmer note in prices has again been established. Best grades of black sheets are considerably better off at present. Producers of galvanised sheets secured a fair amount of business at reduced prices, and are likely to be well employed for some weeks ahead. Prices of these again show a firmer tendency.

Coal.

The coal market has been dull throughout the week. The situation in the West of Scotland is especially unsatisfactory. A number of pits in the district are closed, and employment at those still in operation is, as a rule, intermittent. All fuels are in need of fresh orders, and for export any shipper with a definite order to place can usually secure favourable terms. Producers of best qualities are endeavouring to maintain their prices, but these are often obtainable at cheaper prices through second hands. East of Scotland collieries report a better inquiry for export, but, up to the time of writing at least, the amount of fresh business passing has not improved to any extent, and prices remain a matter of arrangement. Aggregate shipments amounted to 278,181 tons, against 242,100 tons in the preceding week, and 224,113 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE position in the anthracite section is fairly satisfactory, and returns show that exports to Canada, so far this season, are in excess of those of previous years. The value of this market is inestimable, as it provides a substantial outlet for anthracite coals during what was regarded as the quiet season. In the case of the steam coal section, however, the conditions are by no means so good. They are, in fact, very indifferent, and at the moment there is no sign of a re-awakening in the demand from abroad. It may appear strange that business should be so quiet, and yet the returns of exports for the week ended the 20th were a record for the period since the national stoppage of last year. It is evident that there has been a considerable amount of business carried through which has not come on the market in the ordinary way. Such a high level of shipments can scarcely be maintained, as there is not the supply of tonnage at the disposal of the collieries. During the past week or so daily returns have revealed the fact that a number of loading appliances have been idle at several of the docks. The inquiry for coals for delivery promptly is very slow, and this applies to practically all descriptions, except smalls, which are scarce for the reason that so many collieries of late have only been able to work short time. One point stands out very clearly in view of the recent substantial exports, and that is that, considerable as the steps have been towards regaining markets, much more has yet to be done in order to find an outlet for the full production of steam coals in this district, it being evident that the eight hours' day is responsible for a relatively greater output, as compared with the seven hours' day. Reference has been made to the attempts of foreign countries to set up barriers to the importation of British coals, but it is satisfactory to see that the Customs Committee of the French Government has recommended that the proposed duty on anthracite should be eliminated, and that that coal should be entered in the same category as coal and lignite, and should be liable to a fixed duty of 2f. per ton, which is the same as has been in operation. The duty on coke is also to remain, but, unfortunately, the duty on patent fuel is to be raised to 3f. It is fully expected that the French Government will accept the report of the Committee.

The Canning Industry.

The first annual convention of the National Food Council was held at Cardiff on Friday last, when Sir Edgar Jones, K.B.E., presided. Some interesting information was forthcoming regarding the importance of the tinning trade to the tin-plate and allied industries of this district. Sir J. C. Davies, chairman of the Tin-plate Association, said that as regarded imported tinned goods in 1925, they imported vegetables valued at £7,000,000, of which £4,000,000 came from the United States, in addition to £1,000,000 of tinned fruit. They were told by experts that approximately 65 per cent. of such fruit and vegetables could be produced in this country. The increased production of tin-plates to meet that demand would give employment to fully 5000 men at a wage bill of about £750,000 per annum. If it was possible for them to consume the same quantity per head of population as in America, it would mean employment for something like 20,000 men at a wage bill of £3,000,000, for those employed in growing, the tinning engineering industries, and the tin-plate and other industries. He did not think it was appreciated fully in Cardiff that to produce 800,000 tons of tin-plates as they were doing at the present time in South Wales, they required something like 1,000,000 tons of steel, and that in the processes leading up to the making of tin-plates there was consumed about 4,000,000 tons of coal. The number of men they employed in the tin-plate and allied processes was about 68,000, involving a wage bill of about £8,250,000 per annum. That was the importance of the tin-plate industry to this community, and it was therefore in their interests to try and keep the industry going.

Local Trade.

The returns of trade disclosed that for the week ended 20th inst. shipments of coal came to just over 620,000 tons, which was an increase of 80,000 tons upon the figure for the previous week, and constituted a record since the national coal stoppage. The import trade was on a fairly good scale. Pitwood arrivals were on a heavier basis, and amounted to 36,881 loads, while there was a marked recovery in the importation of iron ore, the total coming to hand being nearly 40,000 tons, as against only 5140 tons in the previous week.

British versus Continental Coals.

Sir David R. Llewellyn, a leading Welsh coal-owner, does not agree with much of the report prepared by the five miners' leaders who recently visited the continental coalfields, and who foreshadow a great price-war in the future. His view is that to return to a seven hours' day would be a most retrograde step and would increase costs, thus causing them to again lose the markets which they had recently recovered and bringing about more unemployment for the miners and all in the allied trades. In mechanical appliances, in the recovery of by-products, in the preparation of coal for markets abroad, Great Britain was making more rapid progress than any other country, while in the matter of overhead charges the position in this country was far superior. As regards a pension scheme for miners, he has expressed the opinion that this must come. It was a serious problem that had to be tackled, and while it would add to the cost of production, he considers it essential to find a remedy for the present state of affairs and a pension scheme should be included in the next agreement.

Current Business.

The amount of fresh business passing in steam coals is comparatively small, and the market has a weaker appearance. This is more especially the case with inferior grades of large coals, and even some of the best qualities are none too well off for orders for early loading. On the whole, the market is extremely irregular, and prices are entirely governed by the individual position of collieries, many of whom of late have not been able to work continuously, owing to the quantity of standing stocks and the shortage of empty wagons. Best Admiralty large coals are now round about 22s. 6d., and there is very little business at this figure. Best smalls are quoted up to 15s., while as regards coke and patent fuel, there is no change of note. Pitwood is a shade steadier at 31s. to 32s.

LAUNCHES AND TRIAL TRIPS.

HAMILDOC, single-screw steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Paterson Steamships, Ltd., Fort William, Ontario, Canada; dimensions, 253ft. long. Engines, ordinary inverted marine type; constructed by MacColl and Pollock, Ltd., Sunderland; launch, April 20th.

KINGDOC, single-screw steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Paterson Steamships, Ltd., Fort William, Ontario, Canada; dimensions, 253ft. long. Engines, ordinary inverted marine type; constructed by Swan, Hunter and Wigham Richardson, Ltd., Walker-on-Tyne; trial trip, April 30th.

PORT GISBORNE, twin-screw motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Commonwealth and Dominion Line, Ltd., London; dimensions, 475½ft. by 63ft., to carry 10,000 tons weight of cargo, including meat. Engines, two four-cylinder twin-screw Doxford oil engines; constructed by Neptune Works of Swan, Hunter and Wigham Richardson, Ltd.; launch, April 30th.

BRITISH INDUSTRY, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of British Tanker Company, Ltd.; to carry 6100 tons. Engines, triple-expansion; launch, May 3rd.

ARGUAL, single-screw cargo and passenger steamer; built by Cammell Laird and Co., Ltd., to the order of Elders and Fyffes, Ltd.; dimensions, 300ft. by 44ft. by 25ft. Engines, triple expansion, 20½in., 35in. and 59in. by 42in. stroke, pressure 205 lb. per square inch; launch, May 4th.

CITY OF HEREFORD, single-screw steamer; built by Barclay, Curle and Co., Ltd., to the order of Ellerman Lines, Ltd.; dimensions, 398ft. 6in. by 51ft. 6in. by 32ft. 8in. Engines, triple-expansion, 24in., 41½in., 72½in. by 48in. stroke; a mean speed of 13½ knots was attained on trial trip, May 4th.

TELA, steamship; built by Workman, Clark and Co., Ltd., to the order of United Fruit Company, Boston; dimensions, 355ft. by 48ft. by 31ft. 6in.; to carry fruit and passengers; trial trip, May 4th.

ENCINA AND ENEA, two steel port lighters, built by Harland and Wolff, Ltd., to the order of the Argentine Navigation Company (Nicholas Mihanovich), Ltd., Buenos Aires; dimensions, 90ft. by 28ft. by 7ft. 6in.; to carry 350 tons deadweight on a draught of 7ft.; launch, May 5th.

VAN OUTHOORN, steamship; built by De Maas' Shipbuilding Company, Slikkerveer, Holland; dimensions, 299ft. 10½in. by 45ft. 11in. by 17ft.; to carry 1340 tons deadweight. Engines constructed by Messrs. "Fijnoord," of Rotterdam; launch, May 12th.

TOBONDOC, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Paterson Steamships, Ltd., Canada; dimensions, 253ft. long. Engines, inverted marine type; constructed by Swan, Hunter and Wigham Richardson, Ltd.; trial trip, May 13th.

JUNA, twin-screw steel steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of British India Steam Navigation Company, Ltd.; dimensions, 290ft. long by 43ft. 6in. beam; to carry 2000 tons deadweight. Engines, two sets triple expansion; constructed by Swan, Hunter and Wigham Richardson, Ltd., Neptune Works; launch, May 16th.

CASCO, built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of Canada Starch Company, Ltd., of Montreal; dimensions, 253ft. by 43ft. 3in. by 20ft.; to carry 2450 tons deadweight. Engines, triple-expansion, 17in., 28in., 46in. by 33in. stroke, pressure 180 lb. per square inch; constructed by Earle's Shipbuilding and Engineering Company, Ltd., Hull; launch, May 17th.

BRITISH COLONY, single-screw oil tanker; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of British Tanker Company, Ltd., of London; dimensions, 454ft. by 57ft.; to carry 10,000 tons deadweight on a draught of 26½ft. Engines, triple-expansion; constructed by Swan, Hunter and Wigham Richardson, Ltd. A speed of 11 knots was obtained on the recent trial trip.

KORSOR, motor train ferry; built by Elsinore Shipbuilding Company, to the order of Royal Danish State Railways; dimensions, 96 m. by 17·7 m. by 6·15 m. Engines, two eight-cylinder four-cycle single-acting marine oil; constructed by Burmeister and Wain; trial trip, recently.

CONTRACTS.

THE provision of the fire protection service for the Bath and West and Southern Counties Show, was again entrusted to Merryweather and Sons, Ltd., of Greenwich.

JOHN KIRKALDY, Ltd., of 101, Leadenhall-street, London, E.C. 3, has received orders for evaporating and distilling machinery for H.M. ships Shropshire, Norfolk, Dorsetshire and York.

WORTHINGTON-SIMPSON, Ltd., of Queen's House, Kingsway, London, W.C. 2, have received an order for the supply of oil engines and pumps for the Waikerie Pumping Installation, South Australia. The plant will include one 540 horse-power six-cylinder airless injection oil engine driving an 18in. centrifugal pump; one 360 horse-power four-cylinder oil engine driving a 14in. centrifugal pump; one 270 horse-power three-cylinder engine driving a 12in. centrifugal pump; and one 60 horse-power single cylinder engine driving a 7in. three-stage centrifugal pump.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE B.E.N. PATENTS, Ltd., asks us to announce that on and after May 28th it will change its address from 96-98, Victoria-street, London, S.W. 1, to 92, Tottenham Court-road, London, W.C. 1. Telephone: Museum 1761/2.

BROWETT, LINDLEY AND CO., Ltd., of Sandon Works, Patricroft, Manchester, ask us to announce that they have appointed Messrs. Green and Jackson, of 12, Cherry-street, Birmingham, to be their representatives for the Midlands district.

MR. R. W. SUTTON asks us to announce that he has been appointed by the Court, receiver and manager of the Ransome Machinery Company (1920), Ltd., the head office of which is at Windsor House, 42-50, Victoria-street, Westminster, S.W. 1. It is the intention that the business hitherto carried on by the company shall be continued with a view to reconstruction. Mr. Sutton is, therefore, continuing to carry on trading for that purpose and a scheme for reconstruction of the company is to be prepared.

MESSRS. MERZ AND MCLELLAN, of 32, Victoria-street, Westminster, S.W. 1, announce the introduction of members of their engineering staff into partnership as follows:—(*a*) Mr. H. H. Baker with Mr. C. H. Merz and Mr. W. McLellan in the firm of Merz and McLellan; (*b*) Mr. F. Lydall with Mr. C. H. Merz in the firm of Merz and Partners; and (*c*) Mr. R. Nelson and Mr. A. H. Human with Mr. W. McLellan in the firm of McLellan and Partners. The address will continue to be—32, Victoria-street, Westminster, S.W. 1.

THE ROYAL SCOTTISH MUSEUM, EDINBURGH.—In the annual report of the Royal Scottish Museum at Edinburgh, reference is made to the growth of the technological department. As a result of interest aroused by a temporary loan collection of aeronautical exhibits last summer, three aero engines have been added to the permanent collection. Actual machines include a service machine of the wood and canvas type, and a Supermarine amphibian flying boat, while several models of aeroplanes and examples of aircraft navigational instruments have been acquired. The shipbuilding section has been enlarged by the addition of a collection of models of ships of the mediæval and Elizabethan periods. A reproduction of Murdoch's steam carriage of 1784 has been purchased. In the mining and metallurgical hall, a notable new exhibit is a working model illustrating machine mining. A coal cutter and a face conveyor are shown, and they were made from drawings supplied by Anderson, Boyes and Co., Ltd., Motherwell, and Mavor and Coulson, Ltd., of Glasgow, respectively. Another coal cutter represents the percussion type of machine. Other recent acquisitions include a model horizontal shale retort made from an original sketch by the late James Young, and the first telephone, a copy of the Edison Bell instrument, made and erected in Scotland. Mr. T. A. Edison has presented a special type of lamp with which he discovered the "Edison Effect," and a small microscope made by Barbon, of Princes-street, in 1810, has been purchased.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 4 0	
No. 1 Foundry	4 7 6	—
No. 3 Foundry	4 2 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 19 0	3 19 0
No. 1	3 19 6	3 19 6
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 1 6	—
(3) Northampton—		
Foundry No. 3	3 12 6	—
Foundry Forge	3 8 0	—
(3) Derbyshire—		
No. 3 Foundry	3 15 0	—
Forge	3 12 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 15 0	—
No. 4 Forge	—	—
Basic	3 12 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 13 6 (a); 4 16 6 (b); 5 0 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. Coast—		
Iron Rivets	12 5 0	—
Common Bars	11 15 0	—
Best Bars	12 5 0	—
Lancs.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	10 15 0 to 11 0 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 5 0	—
Gas Tube Strip	12 10 0 to 12 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¼in. and up	8 2 6 to 8 5 0	£8 0 0 to 8 2 6
Sections	7 12 6 to 7 15 0	£7 10 0 to 7 12 6
Steel Sheets, under 3/16 in. to ¼in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0	
Manchester—		
Bars (Round)	8 15 0	—
,, (Small Round)	8 2 6	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 7 6	—
Sheffield—		
Siemens Acid Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 5 0 to 7 10 0	
Hoops	12 0 0	—
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	8 10 0 to 8 15 0	
Billets and Sheet Bars	6 15 0 to 7 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 15 0 to 15 0 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	295 15 0
,, (three months)	287 5 0
Copper (cash)	53 18 9
,, (three months)	54 12 6
Spanish Lead (cash)	24 12 6
,, (three months)	25 1 3
Spelter (cash)	29 0 0
,, (three months)	29 0 0
Manchester—	
Copper, Best Selected Ingots	60 0 0
,, Electrolytic	60 5 0
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	25 17 6
,, Foreign	24 15 0
Spelter	28 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 15 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£36 5 0	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/-
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 2 6 scale 5/- per unit	
,, ,, 75 p.c.	£19 5 0 scale 6/- per unit	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	14/-
,, ,, Ell	14/6
,, ,, Splint	15/6 to 16/9
,, ,, Trebles	14/- to 14/3
,, ,, Doubles	13/- to 13/6
,, ,, Singles	12/9
Ayrshire—	
(f.o.b. Ports)—Steam	13/9
,, ,, Jewel	15/6
,, ,, Trebles	14/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/-
Screened Navigation	18/- to 19/-
Trebles	14/6 to 15/3
Doubles	13/3
Singles	13/-
Lothians—	
(f.o.b. Leith)—Best Steam	13/9
Secondary Steam	13/- to 13/3
Trebles	14/9
Doubles	13/3 to 13/6
Singles	13/-

ENGLAND.

(8) N.W. Coast—	
Steams	27/6
Household	42/6 to 58/6
Coke	27/- to 28/-
Northumberland—	
Best Steams	14/6
Second Steams	13/9
Steam Smalls	10/6
Unscreened	13/6 to 13/9
Household	21/- to 27/-
Durham—	
Best Gas	16/6 to 17/3
Second	14/9
Household	21/- to 27/-
Foundry Coke	23/6 to 26/6

Sheffield—	Inland.
Best Hand-picked Branch	30/- to 31/-
Best Selected House Coal	25/- to 27/6 —
Screened House Coal	22/- to 24/- —
,, ,, Nuts	18/6 to 20/6 —
Yorkshire Hards	18/- to 20/- —
Derbyshire Hards	18/- to 20/- —
Rough Slacks	10/6 to 11/6 —
Nutty Slacks	8/- to 9/- —
Smalls	3/- to 5/6 —
Blast-furnace Coke (Inland)	22/- to 27/6 at ovens.*
,, ,, (Export)	f.o.b. 19/- to 19/6

(9) SOUTH WALES.

Cardiff— Steam Coals:	
Best Smokeless Large	22/- to 22/9
Second ,, ,,	21/- to 22/-
Best Dry Large	20/6 to 21/-
Ordinary Dry Large	19/- to 19/6
Best Black Vein Large	20/6 to 21/6
Western Valley Large	19/6 to 20/-
Best Eastern Valley Large	19/- to 19/6
Ordinary ,, ,,	18/- to 18/6
Best Steam Smalls	14/6 to 15/-
Ordinary Smalls	12/- to 14/-
Washed Nuts	18/- to 22/-
No. 3 Rhondda Large	23/- to 24/-
,, ,, Smalls	16/6 to 17/-
No. 2 ,, Large	19/- to 20/-
,, ,, Through	17/6 to 18/-
,, ,, Smalls	13/- to 14/-
Foundry Coke (export)	40/- to 45/-
Furnace Coke (export)	30/- to 32/6
Patent Fuel	25/- to 26/-
Pitwood (ex ship)	31/6 to 32/6
Swansea— Anthracite Coals:	
Best Big Vein Large	41/- to 45/-
Seconds	30/- to 37/-
Red Vein	27/- to 30/-
Machine-made Cobbles	45/- to 50/-
Nuts	45/- to 47/6
Beans	35/- to 37/6
Peas	20/- to 22/-
Breaker Duff	9/- to 10/-
Rubbly Culm	12/- to 12/3
Steam Coals:	
Large	21/- to 22/-
Seconds	19/- to 21/-
Smalls	11/6 to 12/6
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire. (6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 22/- per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

The Tariff Bill.

THE new Tariff Bill has received a serious check through the refusal of the Chamber of Deputies to pass it without being in possession of full information to allow of a judgment being formed upon the possible effects of the measure on the country's economic future. The Government hoped to get the Bill through practically without debate, and there was no difficulty over the preamble laying down the general lines of the proposed fiscal system, but when it came to the tariff proper the Chamber wanted to know more about what was meant by the duties to be imposed under a particularly complicated classification. The Government insisted that the Bill should be passed at once, on the ground that it was obliged to present a tariff before the present temporary agreement with Germany expired at the end of June ; otherwise, it declared, the negotiations for various treaty arrangements would collapse and the commercial interests of the country would suffer. The Chamber thought that there would be no difficulty in renewing the temporary agreement, if necessary, so that sufficient time could be given for due consideration of a measure which might have vital consequences for France. A demand for a comparative statement of the old duties and the proposed new tariff was at first refused by the Government on the plea that, owing to the new classification, such a comparison was very difficult to make, but as the Chamber began to see that the Tariff Bill was intended to be largely a political measure, it refused to allow politics to be bound up with purely economic questions, and the Government had to give way and promise to provide the information required. The debate on the Bill has, therefore, been postponed. The Government admitted that the measure is intended to provide it with an arm for wresting concessions from other countries, and it claims the right, which the manufacturing interests are resisting, to allow reductions on the minimum tariff in return for equivalent advantages. The trouble arises mainly out of the declared opposition between the industrial and agricultural interests. Manufacturers are solidly in favour of a tariff which has been increased by the Customs Commission to a point at which it is practically prohibitive. At a time when so many official statements have been made at Geneva and elsewhere to the effect that France aims at carrying out a liberal policy of trade expansion with all countries, members of the Government declared in the Chamber of Deputies that it was essential to the country's future that all branches of industry should be adequately protected, which really means that for purposes of national defence the country should be capable of producing everything, whether economically or not. Such statements provided the agricultural and commercial interests with arguments to the effect that the policy proposed to be followed by the Government would inevitably increase living costs considerably. The plea that the high import duties would bring in further revenue to the State and avoid the necessity of imposing new taxes, which the country absolutely refuses to accept, was met with the reply that import duties are not paid by the foreign manufacturer but by the consumer at home, so that taxpayers would be burdened with the duties in addition to the higher living cost. Agriculturists who constitute the vast majority of the country, and are powerfully organised, declare that they are tired of being charged with responsibility for the high cost of living. They complain that they are protected to a far less extent than manufacturers, and that the only way of getting down living costs is to provide them with the means of carrying on their business economically, which is only possible by the free importation of what they require. During the past week, therefore, the whole question of the Tariff Bill has assumed a different aspect, and there is some indication that the measure will lose its present prohibitive character before it is finally adopted.

Foreign Trade.

An analysis of the returns of foreign trade during the first four months of the year is instructive as showing the effects of the stabilisation of the franc upon business with other countries. The franc has remained at its present level for more than a month, and during April there was a decline, as compared with the previous month, both in quantities and values of imports and exports, the declension of the latter being nearly four times that of the imports. In the first four months the total value of imports was 17,571 million francs, a diminution of 2186 million francs, as compared with the similar period of 1926, and the values of exports totalled 18,254 million francs, an increase of 649 million francs. So far as quantities were concerned exports amounted to 17,540,800 tons during the four months, an increase of 1,652,785 tons, this being due principally to raw material, the value of which, however, underwent a heavy decline. The French, therefore, have been getting cheaper raw material, chiefly coal, but their purchases of manufactured goods have been less, and they paid much more for foodstuffs, probably grain, to make up for the home deficit. The exports amounted to 11,787,473 tons, an increase of 1,232,256 tons. Raw material exports increased by more than a million tons, and manufactured goods totalled 1,684,211 tons, an increase of 245,449 tons, but as the value declined by more than 70 million francs, French makers, on account of the currency appreciation, are getting less for their products. This creates an unsatisfactory situation as, despite the cheaper raw material imported, manufacturing costs have not declined, and have even a tendency to increase. Although there is still a surplus of exports over imports, the comparison of April with the previous month shows a contraction through smallness of purchases abroad and a general falling off in exports. In the discussion upon the economic policy of France, attention is centred very largely upon the necessity of increasing the "balance of trade" by producing everything possible at home, and exporting, but fortunately economists are beginning to make it clear that the balance of trade can only be maintained under normal conditions by the country exporting what it can produce economically, and importing cheaply what is necessary to insure that economical production.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

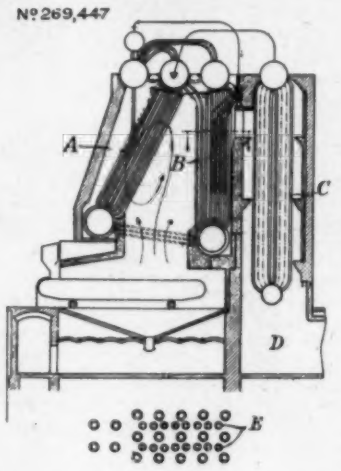
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application ; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

269,447. June 1st, 1926.—WATER-TUBE BOILERS, *E. C. R. Marks*, 57, *Lincoln's Inn-fields, London, W.C.* 2.

In this boiler, which, it is suggested, is suitable for pressures up to 100 atmospheres, there are two distinct banks of water tubes A and B, and an economiser C. The flue is shown at D. It will be noticed that there is a tendency for the furnace gases to take a direct path to the flue through the tubes B and that

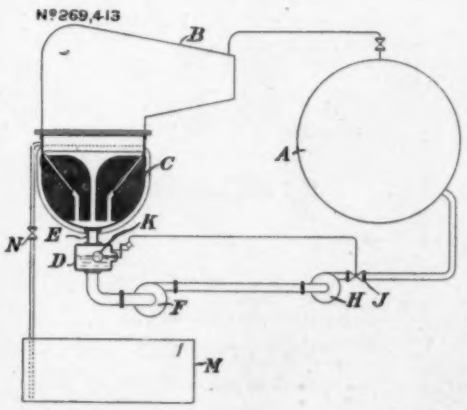


the tubes A would then be heated only by radiation. In order to equalise the evaporation effect of the two banks of tubes, superheater tubes E—see small sketch—are arranged among the bank B. It is said that these superheater tubes dam back the furnace gases and constrain them to follow the path indicated by the bent arrow so that they flow through the bank A.—*April 21st*, 1927.

CONDENSERS AND FEED-WATER HEATERS.

269,413. October 13th, 1926.—CLOSED FEED SYSTEMS, G. and J. Weir, Cathcart, Glasgow ; and J. G. Weir.

The object of this invention is to obviate the necessity for a feed tank in connection with a closed feed condensing system for normalising the level of the condensate in the condenser. This object is attained, according to the present invention, by providing a steam generator of ample water capacity, arranging for the feed pump to be controlled by a float in a well in or connected to the bottom of the condenser, and providing a water extraction pump to withdraw the water from the condenser and deliver it to the feed pump. A boiler A supplies steam to a steam turbine B. The turbine exhausts into a condenser C. The condensate from the condenser flows into a small tank or well D with which the condenser is connected. The condensate is withdrawn from the well D by the water extraction pump F, which is of the centrifugal type and is arranged to run at a con-

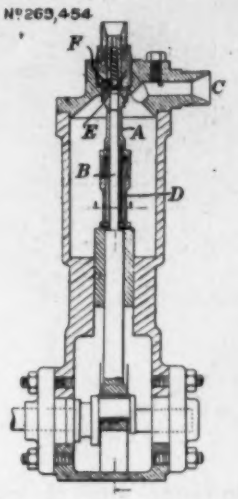


stant speed. The water extraction pump discharges directly to a boiler feed pump H which in turn supplies the boiler through a valve J. A float K is arranged within the well D and is adapted to control the output of the boiler feed pump by acting on the valve J. The arrangement is such that, when the float K falls, it acts to close the valve J ; it acts to open the valve when it rises. If the float falls, the quantity of water delivered by the boiler feed pump will be reduced and thus the fall of level in the well D will be checked. On the other hand, if the float rises, the boiler feed pump will deliver more water and the rise of water in the well D will be checked. The level of water in the well D is thus maintained substantially constant, and a substantially constant head of water is maintained on the suction side of the water extraction pump F. A feed tank M having a connection to the top of the condenser is provided for the purpose of enabling losses in the feed water to be made up. The connection is provided with a hand-controlled valve N.—*April 21st*, 1927.

INTERNAL COMBUSTION ENGINES.

269,454. January 5th, 1927.—FUEL PUMPS, L. H. L. Bellem, 34, Rue de Chateaudun, Asnières (Seine), France.

The cylinder of this pump is shown at A and the piston at B. The piston is reciprocated by any convenient mechanism. The whole pump is flooded with oil supplied at C. The cylinder A is not attached to the casing, but merely embraces the piston. There is, however, a split sleeve at D, which grips the piston and tends to drag the cylinder along with the stroke of the piston. There is another sleeve for limiting the downward stroke of the entrained cylinder. The action of the apparatus is as follows :—The piston and cylinder move together until the cylinder is

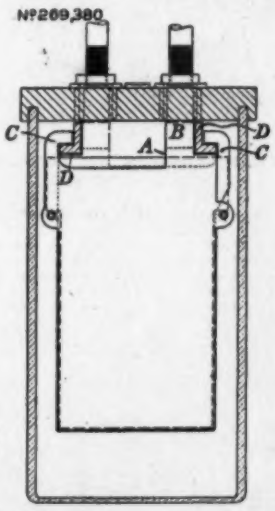


arrested by the sleeve. The piston proceeds downward and the bore fills with oil. On the upstroke the two move together until the cylinder beds on the conical seating E, when the piston in the continuation of its stroke, discharges the oil fuel through the non-return valve F. It will be understood that the position of the stop sleeve determines the amount of oil delivered at each stroke.—*April 21st*, 1927.

BATTERIES AND ACCUMULATORS.

269,380. July 28th, 1926.—IMPROVEMENTS IN AND RELATING TO SECONDARY ELECTRIC BATTERIES, "Hart" Accumulator Company, Ltd., and Charles Rupert Hardy, both of 35, Marshgate-lane, Stratford, London, E. 15.

It is usual for the plates of covered secondary batteries either to rest upon bottom supports or to be suspended by small lugs cast in the vertical edges and resting upon vertical slabs of insulating material or ledges in the container. These supports are, however, liable to permit the formation of a bridge of sediment between plates of opposite polarity. In the case of plates that rest upon bottom supports any vertical "growth" of the plates can only take place by the upper edge rising, and there is



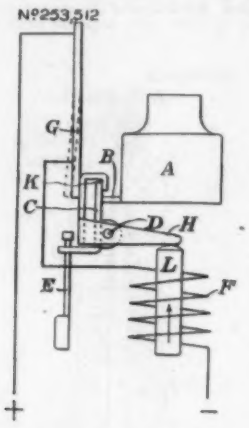
a danger of either pushing the lid off or of causing distortion. According to the invention, each plate is formed with a lug A and all plates of the same kind are united by a bus-bar, from which a connector projects upwards through the lid. At the points C hooks are provided, and beneath these hooks there are L-shaped insulators D extending the whole length of the cell. It will thus be seen that as the plates hang freely in the container there is nothing upon which a bridge of sediment can form. Normally the insulators D will be above the level of the electrolyte, but even if sediment should deposit upon them there will be no short circuit between plates of opposite polarity. The plate is also free to "grow" in both directions.—*April 21st*, 1927.

SWITCHGEAR.

253,512. June 2nd, 1926.—IMPROVEMENTS IN AND RELATING TO ELECTRIC SWITCHES, *International General Electric Company, Incorporated, of* 120, *Broadway, New York.*

The switch forming the subject of this invention is provided with a time lag overload device. The switching member is placed within a casing A and is operated through a rod B by the member C, which rotates about the pivot D. The spindle E is secured to the operating member C for resetting or for moving it in an anti-clockwise direction about the pivot, *i.e.*, in the cutting-out direction. F is an electro-magnet and G a thermostatic device consisting of a bi-metallic strip, which, when heated, deflects to the position indicated by the dotted lines. A bell crank lever H pivoted at D can be engaged by the electromagnet F and the thermostatic device G. The lever H is loosely coupled with the operating member C so as to allow free movement of the latter in the cut-out direction, and for that purpose it is provided with a hooked end K engaging the operating member C. When an excess current is maintained until the device G has taken up the position shown in dotted lines, the operating member C is actuated by the core L, which moves in the direction shown by the arrow. On opening the controlling circuit, how-

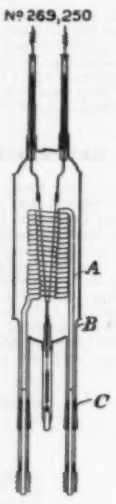
ever, the core L and intermediate member C can immediately return to their set positions before the device G has cooled and the operating lever C can then be re-set. In the case of an over-



oad that is insufficient and does not last long enough to deflect the device G to the dotted position, the operating member C will not be actuated.—*April* 21*st*, 1927.

TELEGRAPHS AND TELEPHONES.

269,250. January 14th, 1926.—IMPROVEMENTS IN AND RELATING TO THERMIONIC VALVES FOR WIRELESS TELEGRAPHY AND TELEPHONY, John Knowles im Thurn and Harold Morris-Airey, both of H.M. Signal School, R.N. Barracks, Portsmouth.

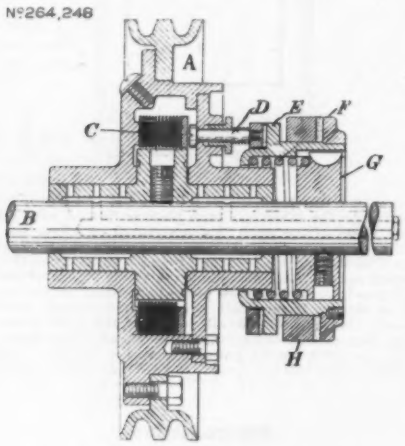


The anode of the valve which forms the subject matter of this invention is cooled by means of water or oil or other liquid, thus increasing the rating of the valve. The anode is composed of a metal tube A, the leads from which are brought through the silica envelope B, through special seals C. The liquid for cooling the valve is, of course, circulated through the tubing. The seals form the subject of another patent, viz., 23,854/1913. When oil is used for cooling, the anode forms part of an oil circulating system, such as a pump and cooling device as commonly employed for cooling transformers. The shape and number of the hollows, or tubular portions of the anode, it is stated, may be altered or modified without departing from the scope of the invention.—*April* 14*th*, 1927.

TRANSMISSION OF POWER.

264,248. October 17th, 1925.—FRICTION CLUTCHES, J. Ruscoe and Co., Ltd., Albion Works, Hyde, Chester; and G. H. Kenyon.

This clutch is primarily intended for the driving pulleys of spinning and doubling frames. The pulley A is driven by the shaft B through a plate clutch C in the usual manner, the plates being kept in engagement by the pressers D. These pressers are normally pushed forward by the sleeve E and the spring F,

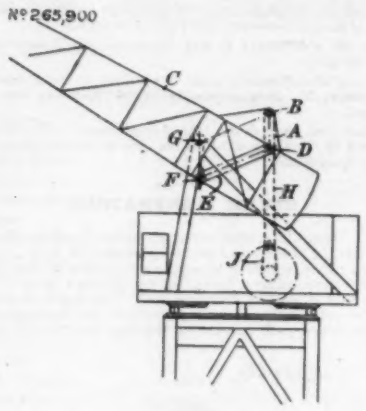


which abuts against the collar G keyed to the shaft. Surrounding the sleeve there is a ring H which can be moved axially by any convenient gear. Moving this ring to the right has the effect of slackening the pressure between the clutch plates C and incidentally produces a braking effect on the pulley, so that a very wide range of speeds can be obtained by allowing the clutch to slip.—*January* 17*th*, 1927.

CRANES AND CONVEYORS.

265,900. September 2nd, 1926.—LEVEL LUFFING CRANES, T. Sonness, 22, Orchard-avenue, Finchley, London, N. 3.

In this crane level luffing is effected by means of a mechanism which comprises a link A, one end of which is pivoted at B to the jib C, whilst the other end is pivoted at D to one end of a second link E pivoted to the frame at F, the arrangement being such that if lines be drawn from the fulcrum G of the jib to the pivot B and from the fulcrum G to the pivot F, a parallelogram will be formed with the links A and E. During the luffing of the jib the link A will consequently always be parallel with the line joining G and F. H is a connecting-rod pivoted at one end to



the pivot D and at the other end to a crank J geared to the luffing machinery unit.—*February* 17*th*, 1927.

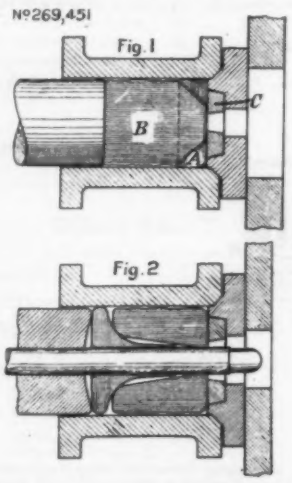
MACHINE TOOLS AND SHOP APPLIANCES.

269,411. October 11th, 1926.—REAMERS, S. A. Erwin, Santa Fé Springs, Los Angeles County, California, and E. W. Forrow, 2032, West 80th-street, Los Angeles.

This invention relates to rotary reamers used in well drilling, and a purpose of the invention is the provision of a reamer having a mandrel upon which a plurality of cutters are removably secured to permit with facility and dispatch the substitution of new cutters when they become worn or broken, and the employment of cutters of different size when it is desired to vary the size of the reamer as a whole. The reamer is intended for reaming out deep bore-holes, and its character may be well described by the first claim of the specification, which runs as follows:—"A well reamer comprising a hollow mandrel carrying a plurality of disc-like toothed cutters inclined to the axis of the mandrel and spaced apart by means of spacing rings interposed between the cutters." It should be noted that the upper packing washer A is screw-threaded on to the mandrel, and that the cutter discs are said to be fixed immovably.—*April* 21*st*, 1927.

269,451. December 20th, 1926.—MANUFACTURE OF SHEATHED METAL RODS AND BI-METALLIC TUBES, Robert Bosch Aktiengesellschaft, 4, Militärstrasse, Stutgart, Germany.

This invention is concerned with the production of metal rods and tubes coated with a layer of another metal by an extruding process. A wedge-shaped ring A of the sheathing metal and a conically pointed piece of core metal B are placed in the press and extruded through the die C. It is said that: "On suitable pressure being exerted by the piston, the block B, which has been brought up to the temperature suitable for pressing, is forced through the die C issuing as a rod. A certain

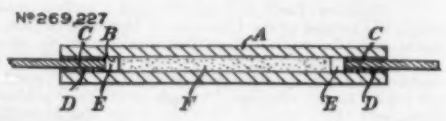


amount of the metallic ring A will also be taken at the same time along with the metal of the core flowing through the die, and this metal is retained on the metal core of the rod originating from the block B as an absolutely uniform, firmly adherent sheathing. This sheathing adheres as firmly as if it had been welded to the metal core, and is also absolutely uniform along the whole length of the rod. Rods may be extruded up to 30 m. length and more." For making sheathed tubes the arrangement shown in Fig. 2 is adopted. A mandrel is used to determine the bore, and the two metals are made up in the forms shown. It is said that the relative thickness of the sheath can be controlled.—*April* 21*st*, 1927.

MISCELLANEOUS.

269,227. December 17th, 1925.—IMPROVEMENTS IN THE MANUFACTURE OF ELECTRICAL RESISTANCES, The Morgan Crucible Company, Ltd., and Colin Clarence Gow, both of Battersea Works, Church-road, London, S.W. 11.

The manufacture of resistances of ceramic material containing carbon or other conductive materials give rise to considerable difficulties when the resistance must have a definite ohmic value, and the object of this invention is to overcome these difficulties. The resistance material shown is in the form of a rod A, and it has a slightly higher resistance than that required. The rod has a hollow core B, with terminals C at the ends, and



these terminals are inserted to a distance in the hollow core to give the desired resistance contact with the hollow part of the resistance material A. At the points D powdered metal butts against lead plugs E, and the space between the plugs is filled with sand F or a glass rod or other insulating material.—*April* 19*th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF PRODUCTION ENGINEERS.—Council Room, Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "Rate Fixing," by Mr. J. Ronald. 7.30 p.m.

THE PHYSICAL SOCIETY.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "A Duplex Reversal Key with Mercury Contacts," by Messrs. Ezer Griffiths, D.Sc., F.R.S., and Edgar A. Griffiths; "The Measurement of the Inductances of Four-terminal Resistance Standards," by Mr. L. Hartshorn; "Magnetic Disturbances and Aurora as Observed by the Australian Antarctic Expedition in Cape Denison in 1912 and 1913," by Mr. C. Chree, Sc.D., F.R.S.; "Series in the Spectrum of Trebly-ionised Tin (Sn IV)," by Mr. K. R. Rao. A demonstration of the production of splashes by electric discharge will be given by Mr. G. L. Addenbrooke. 5 p.m. Editing Committee meeting at 3.45 p.m. Council meeting at 4 p.m.

ROYAL INSTITUTION, 21, Albemarle-street, W. 1. Discourse "Gabriel Y. Galan, Contemporary Spanish Poet," His Excellency the Márquis de Merry del Val. 9 p.m.

FRIDAY AND SATURDAY, MAY 27TH AND 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Newport, South Wales District Meeting. 10.45 a.m. and 9.30 a.m. respectively.

SATURDAY, MAY 28TH.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the Shell Haven Installation of Shell-Mex, Ltd. 1 p.m.

THURSDAY, FRIDAY AND SATURDAY, JUNE 2ND TO 4TH.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Scottish District meeting at Dunfermline.

MONDAY, MAY 30TH.

THE SURVEYORS' INSTITUTION.—12, Great George-street Westminster, S.W. 1. Annual general meeting in the Lecture Hall at 5 p.m.

FRIDAY, JUNE 3RD.

ROYAL INSTITUTION, 21, Albemarle-street, W. 1. Discourse. "Carlyle as an Historian," by Mr. George M. Trevelyan. 9 p.m.

PHYSICAL SOCIETY.—Imperial College of Science. Lecture and discussion on the forthcoming eclipse of the sun. 5 p.m.

SATURDAY, JUNE 4TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Eastern District meeting at Maidstone.

TUESDAY, JUNE 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Visit to the Kent Cement Works at Greenhithe by steamer, which will start from Westminster Bridge Pier at 10 a.m.

LOUGHBOROUGH COLLEGE: BRITISH EMPIRE SCHOLARSHIPS.—The award of British Empire Scholarships in the Faculty of Engineering, Loughborough College, has now been made. The scholarships are tenable at Loughborough for the full period of the diploma course, and the governors of the College have approved of the following awards for 1927:—(1) G. Macleod, Stockport Municipal College; (2) W. H. Medcalf, Woodbridge School, Suffolk; (3) T. Marash, Scots College, Galilee; (4) J. le P. Webb, Cheltenham Grammar School; (5) R. G. Martin, Wyggeston Grammar School, Leicester; and (6) *aq.* G. L. Ryan and F. Laurence, Loughborough Junior College. These scholarships are open to all British subjects resident in any part of the Empire and are of the value of £75 per annum. Applications were received from a large number of the public and secondary schools in England, Canada, South Africa, Malta, Palestine and India.

THE ELECTROLUX WORKS, LUTON.—On Wednesday of last week, May 18th, we attended, in the company of others, at the official opening of the Electrolux Works at Luton, Bedfordshire. The opening ceremony was performed by Sir Robert Horne, and following it the visitors were shown over the factory and later were entertained to luncheon. The works, situated at Lengrave, on the outskirts of Luton, were originally erected by Hewlett and Blondeau, Ltd., for the manufacture of aeroplanes, and were acquired by Electrolux, Ltd., about twelve months ago. They are engaged to-day on the production of electric vacuum cleaners and of domestic refrigerating apparatus of the Platen-Munters type, as described in our issue of February 19th, 1926. At present the buildings cover an area of 200,000 square feet, but in the near future it is hoped considerably to extend them, for which purpose and also for the purpose of providing a site for a model village at a later date, over 200 acres of neighbouring land have been acquired. The factory is organised on mass production lines, and is equipped as far as possible with British made machinery and plant. About 1200 hands are employed.